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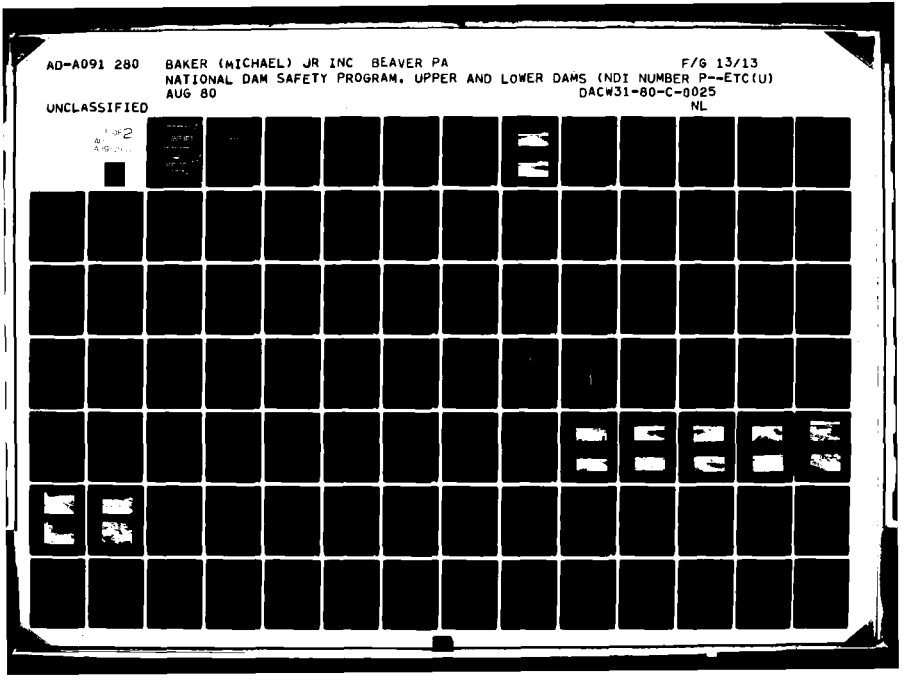

UPPER AND LOWER DAMS

LEVEL

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DACW31-80-C-0044

DEPARTMENT OF THE ARMY

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OHIO RIVER BASIN

National Dam Safety Program.

UPPER AND LOWER DAMS.
~~CRAWFORD COUNTY, COMMONWEALTH OF PENNSYLVANIA~~
NDI ~~No.~~ PA 00389,
PennDER ~~No.~~ 20-55,
SCS ~~Nos.~~ PA 487A and B
Crooked Creek,
Crawford County, Pennsylvania.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared for: DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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410715

PREFACE

This report is prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Upper and Lower Dams, Crawford County, Pennsylvania
NDI No. PA 00389, PennDER No. 20-55, SCS Nos. PA 487A and B

Crooked Creek
Inspected 14 May 1980 and 26 June 1980

ASSESSMENT OF GENERAL CONDITIONS

Upper and Lower Dams, owned by the Pennsylvania Game Commission, are used to reduce floodwater damages in the Little Shenango River Watershed and for waterfowl habitat enhancement. Lower Dam is classified as an "Intermediate" size - "High" hazard dam. The majority of Upper Dam is inundated prior to the pool at Lower Dam reaching the emergency spillway crest (100-year flood) level. Therefore, this report has focused on Lower Dam as the primary dam. Upper Dam is within the flood pool of Lower Dam and is considered equivalent to a secondary impoundment in this report. Both dams were found to be in good overall condition at the time of inspection.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District, U.S. Army Corps of Engineers, for Phase I Inspection Reports, revealed that the spillways will pass the Probable Maximum Flood (PMF) without overtopping Lower Dam. A spillway design flood (SDF) equal to the PMF is required for Lower Dam. Therefore, the spillways are considered "adequate."

The inspection revealed only one deficiency which should be corrected immediately, namely, the repair of the chipped concrete on the impact basin of Upper Dam.

It is recommended that the wet areas below the right side toe of Lower Dam's embankment be visually examined in future inspections and the condition recorded.

In addition, the following operational measures are recommended to be undertaken by the owner:

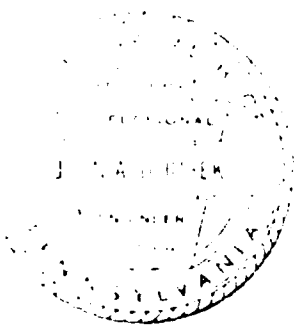
1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, the owner

should activate the emergency operation and warning system.

It is also recommended that the maintenance and operations be recorded and these records maintained for future reference should it become necessary.



Submitted by:

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Date: 26 August 1980

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 12 Sep 80

UPPER AND LOWER DAMS

Overall View of Lower Dam from Right End of Embankment

Overall View of Downstream Slope of Lower Dam from Right End of Embankment

TABLE OF CONTENTS

APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
UPPER AND LOWER DAMS
NDI No. PA 00389, PennDER No. 20-55, SCS Nos. PA 487A and B

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority - The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Upper and Lower Dams consist of two dams in series designed by the U.S. Department of Agriculture, Soil Conservation Service (SCS) for floodwater detention and waterfowl habitat enhancement. Lower Dam is the primary structure upon which this report focuses because the majority of Upper Dam becomes inundated by backwater from Lower Dam before the emergency spillways at Lower Dam are activated. Consequently, Upper Dam was not given a separate National Dam Inventory Number. Pertinent data for Upper Dam have been included in this report.

Lower Dam consists of an earthfill embankment, a centrally located principal spillway (outlet works), and two separate emergency spillways (one at each abutment). Upper Dam consists of an earthfill embankment, a principal spillway (outlet works), and two separate emergency spillways (one at each abutment).

Lower Dam's embankment is zoned with sandy silt upstream and in the central portion. The downstream slope is constructed of more pervious silty sand. A silty clay cut-off trench was installed along the centerline of the dam. The embankment is 20 feet high and 870 feet long. The left emergency spillway is 640 feet wide at the top and

the right emergency spillway is 190 feet wide at the top. This gives a total length of the dam of 1700 feet. The top width of the embankment is 12 feet and the side slopes are both 3H:1V (Horizontal to Vertical). A drainage system consisting of a 12 inch diameter perforated asbestos cement pressure pipe was installed in a drainage fill trench in the downstream slope foundation. Outlets for these drains were provided through the side walls of the principal spillway impact basin.

The principal spillway for Lower Dam is a drop-inlet structure consisting of a three-stage reinforced concrete riser connected to a 54 inch diameter reinforced concrete outlet pipe. The low-level orifice is a 54 inch diameter opening with an invert elevation of 1007.0 feet Mean Sea Level (M.S.L.). A Rodney Hunt slide gate controls the volume of flow through this orifice. The second stage orifices are two 5 feet wide by 3 feet high openings on each side of the riser unit in the upstream half of the riser. The invert elevation of these inlets is 1010.0 feet M.S.L. The volume of flow through these inlets can be controlled by inverted Rodney Hunt slide gates (size is the same as the opening). The observable portions of all three gates, except for the housing, were constructed of stainless steel. The upper-level intake consists of four concrete overflow weirs with rounded downstream edges. The weirs are located on both sides of the riser unit. The crest elevation of these weirs is 1014.0 feet M.S.L. Each weir is 6.25 feet long and the vertical clearance above the weir to the soffit of the riser cap is 3.5 feet. The openings to the low-level orifice and the upper-level overflow weirs are protected by metal trash racks.

The 54 inch outlet conduit (Lower Dam) from the riser unit is 90 feet long and has three anti-seep collars. The pipe exits into a concrete impact basin at the downstream toe of the embankment. The outlet conduit was placed on a reinforced concrete cradle throughout the entire length.

There are two vegetated trapezoidal earth emergency spillway channels for the Lower Dam, one at each abutment. At the left abutment, the base width is 600 feet with 3H:1V side slopes. At the right abutment, the base width is 150 feet with 3H:1V side slopes. The control section elevation for both emergency spillways is 1019.4 feet M.S.L.

A remote dike is located to the right and slightly upstream of Lower Dam. This dike was installed to divert flow from Patton Run along the Bessemer and Lake Erie Railroad located to the right of the reservoir. The flow from this area bypasses the Lower Dam.

Upper Dam is located approximately 5000 feet upstream from Lower Dam. At the location of the principal spillway, a 116 foot long embankment was constructed to Elevation 1024.0 feet M.S.L. The remaining 840 feet of the embankment was constructed to be inundated by backwater from Lower Dam at Elevation 1018.0 feet M.S.L. An existing township road embankment was used as the central portion of the dam embankment. Fill was placed on both sides and on top of this existing roadway embankment to finish at the above mentioned elevations. The top width of the embankment is 12 feet. The dam slopes at the principal spillway are 3H:1V and the slopes of the section of the dam that would be inundated are 5.5H:1V. Riprap was provided for both the upstream and downstream side of the section of the dam that would be inundated. No drainage system was provided for this dam.

The length of Upper Dam is ill-defined because of a low area in the left abutment of the dam. According to the design plans, the left emergency spillway is 400 feet wide at the base. The emergency spillway is shown ending at a small existing knoll at the left; however, an area lower than the top of dam exists to the left of this knoll. It could not be determined whether any or part of this area would function as an emergency spillway prior to backwater from the Lower Dam inundating the area. Another emergency spillway channel is located at the right end of the reservoir. This channel has a base width of 150 feet and is separated from the dam by a pre-existing knoll 370 feet long (along the centerline of the dam). This knoll is well forested and varies in elevation from 1018 to 1021 feet M.S.L. The crest elevation of both emergency spillways is 1017.0 feet M.S.L.

The principal spillway for the Upper Dam is a drop-inlet structure with a two-stage reinforced concrete riser connected to a 54 inch diameter reinforced concrete outlet pipe. The low-level inlet on the concrete riser is a 54 inch diameter orifice. The flow through the orifice can be controlled by a 54 inch diameter Rodney Hunt slide

gate. The observable portions of this gate, except for the housing, were constructed of stainless steel. The invert elevation of this orifice is 1010.0 feet M.S.L. The upper-level intake consists of four concrete overflow weirs with rounded downstream edges. The weirs are located on both sides (right and left) of the riser unit. The crest elevation of these weirs is 1016.0 feet M.S.L. Each weir is 6.25 feet long and the vertical clearance from the crest to the soffit of the riser cap is 3.5 feet. The openings to the orifice and overflow weirs are protected by metal trash racks.

The 54 inch diameter pipe from the riser unit is 70 feet long and has two reinforced concrete anti-seep collars. The pipe is supported throughout its length by a reinforced concrete cradle. The conduit exits into a concrete impact basin at the downstream toe of the embankment.

Located in the northwest corner of the reservoir area for Upper Dam is an L-shaped embankment dike. This dike was installed to protect a pre-existing cemetery. The embankment has 3H:1V side slopes and a 12 foot crest width. The top elevation was set at Elevation 1024.2 feet M.S.L. The length of the embankment is 1040 feet. A 15 inch diameter corrugated metal pipe with a flap gate at the downstream side would drain the area should it become full of water.

On the north side of the reservoir area is a roadway embankment and overpass for U.S. Route 322. A stop log structure controls the water elevation of the swampy area to the north of this embankment and a culvert through the embankment discharges into the channel which enters Upper Dam's reservoir. It appears that this area was not included by the SCS in the drainage areas for Upper and Lower Dams, but as is discussed further in Section 5, the effect of this additional drainage area is considered minimal.

b. Location - Upper and Lower Dams are located in East and West Fallowfield Townships, Crawford County, Pennsylvania. The coordinates of Lower Dam are N 41° 31.3' and W 80° 21.7' and those of Upper Dam are N 41° 32.2' and W 80° 22'. Upper and Lower Dams can be located on the USGS 7.5 minute topographic quadrangle, Conneaut Lake, Pennsylvania.

c. Size Classification - The maximum height of Lower Dam is 20 feet and the reservoir volume at the top of the dam is 7810 acre-feet. The dam is therefore in the "Intermediate" size category.

d. Hazard Classification - There are 2 homes, 1 barn, 3 garages, and 1 township road bridge located approximately 2700 feet downstream from Lower Dam. Loss of life in these structures is possible in the event of a dam failure. The dam is therefore in the "High" hazard category.

e. Ownership - Upper and Lower Dams are owned by the Pennsylvania Game Commission, Harrisburg, Pennsylvania.

f. Purpose of Dam - Both Upper and Lower Dams are used for waterfowl habitat enhancement and flood prevention.

g. Design and Construction History - The dams were designed by the SCS in January through April of 1966. Revisions to the design of the dams were completed in 1971 and 1972. The design drawings were prepared in 1972. The dams were constructed by Milano Construction Company. Construction of the dams was completed in November 1973.

h. Normal Operational Procedures - The pool elevations of both Upper and Lower Dams are fluctuated throughout the year to provide for waterfowl habitat enhancement. The dams are inspected twice a year according to the operation and maintenance agreement and in accordance with standard SCS procedures for SCS dams of this type. Pennsylvania Game Commission personnel perform the routine maintenance on the dam.

1.3 PERTINENT DATA

a. Drainage Area (square miles) -

Upper Dam -	12.8
Lower Dam -	22.6

b. Discharge at Dam Site (c.f.s.) -

Lower Dam Total Spillway Capacity at Minimum Top of Dam (El. 1024.0 ft. M.S.L.) -	20,216
Maximum Flood -	Unknown

c. Elevation (feet above M.S.L.) -

Design Top of Dam - Upper -	1018.0
Lower -	1024.0
Maximum Design Pool - Lower -	1022.6
Emergency Spillway Crest - Upper -	1017.0
Lower -	1019.4
Riser Crest - Upper -	1016.0
Lower -	1014.0
Invert of Low-Level Outlet - Upper -	1010.0
Lower -	1007.0
Normal Pool - Upper -	1016.0
Lower -	1014.0
Exit Invert of Outlet Pipe - Upper -	1008.5
Lower -	1005.5
Streambed at Toe of Dam - Upper -	1013.5
Lower -	1004
Maximum Tailwater -	Unknown

d. Reservoir (feet) -

Length of Maximum Pool (El. 1024.0 ft. M.S.L.) - Combined -	13,000
Length of Normal Pool - Upper (El. 1016.0 ft. M.S.L.) -	5000
Lower (El. 1014.0 ft. M.S.L.) -	4000

e. Storage (acre-feet) -

Top of Dam - Combined (El. 1024.0 ft. M.S.L.) -	7810
Maximum Design Pool - Combined (El. 1022.6 ft. M.S.L.) -	6490
Crest of Emergency Spillway - Combined (El. 1019.4 ft. M.S.L.) -	3940
Normal Pool - Upper (El. 1016.0 ft. M.S.L.)-	700
Lower (El. 1014.0 ft. M.S.L.)-	850

f. Reservoir Surface (acres) -

Top of Dam - Combined (El. 1024.0 ft. M.S.L.) -	934
Maximum Design Pool - Combined (El. 1022.6 ft. M.S.L.) -	894
Crest of Emergency Spillway - Combined (El. 1019.4 ft. M.S.L.) -	770
Normal Pool - Upper (El. 1016.0 ft. M.S.L.)-	252
Lower (El. 1014.0 ft. M.S.L.)-	193

g. Dams -

1) Lower -

Type -	Earthfill
Length (feet) -	1700
Height (feet) -	20
Crest Width (feet) -	12
Slopes - Upstream -	3H:1V
Downstream -	3H:1V

Zoning - The embankment was constructed in three zones. Zone I consisted primarily of sandy silt (ML) and was placed on the upstream slope and central core of the dam. Zone II consisted of silty sand (SM) and was placed in the downstream slope. Zone III consisted of a silty clay (CL) and was placed in the cut-off trench along the centerline of the dam. (See Plate 4.)

Cut-off - Zone III material, consisting of silty clay (CL), was placed in a cut-off trench along the centerline of the dam. The bottom width was designed at 12 feet with 2H:1V side slopes to stripping grade. The depth below existing ground is shown on Plate 5.

Impervious Core - See Zoning above

Grout Curtain - None

Drains - The drainage system for the dam consists of a 12 inch diameter perforated asbestos cement pressure pipe in a sand and gravel drainage fill trench. The drainage fill trench runs the entire length of the dam. The drain pipe runs from 370 feet left and 390 feet right of the principal spillway to outlets in the impact basin of the principal spillway. The right drain was flowing at 1 g.p.m. (See Plate 12 for details.)

2) Upper -

Type -	Earthfill
Length (feet) -	Approximately 2000
Height (feet) -	5
Crest Width (feet) -	12
Slopes[1] - Upstream -	3H:1V
Downstream -	3H:1V

[1]The portion of the embankment constructed to El. 1018.0 ft. M.S.L. has 5.5H:1V upstream and downstream slopes.

Zoning - The dam was constructed along the centerline of an existing township road embankment. This existing road embankment was incorporated into the fill as the central portion. Zone I material consisting of a sandy clay (CL) was placed on both sides and above the road embankment. A small layer of Zone II material was placed at the base of the downstream slope. Zone II type material consisted primarily of gravelly sand (SM). (See Plate 10 for details.)

Cut-off - None

Impervious Core - None

Grout Curtain - None

Drains - None, however, the Zone II fill described above was reported as "moderately permeable" in the soil mechanics laboratory report. Thus the intention might have been for this layer to function as a drainage blanket. However, its effectiveness is doubtful because the sieve analysis showed 16 percent fine material.

h. Diversion and Regulating Tunnel - None

i. Spillways (Emergency Spillways) -

Lower Dam -

At Left Abutment

Type - Vegetated trapezoidal earth channel

Length (feet) - 400

Base Width Perpendicular to Flow (feet) - 600

Side Slopes - Left - 3H:1V

Right - 3H:1V

Crest Elevation (feet M.S.L.) - 1019.4

Gates - None

Downstream Channel - Flows would pass through a well vegetated area, through a wooded area, and into the downstream channel from the principal spillway.

At Right Abutment

Type - Vegetated trapezoidal earth channel

Length (feet) - 625

Base Width Perpendicular to Flow (feet) - 150

Side Slopes - Left - 3H:1V

Right - 3H:1V

Crest Elevation (feet M.S.L.) - 1019.4
Gates - None
Downstream Channel - Flow would pass through a grassy area, enter a remaining portion of the original stream channel, and then join with the channel from the principal spillway.

Upper Dam -

At Left Abutment
Type - Vegetated trapezoidal earth channel
Length (feet) - 12
Base Width Perpendicular to Flow (feet) - 400
Side Slopes - Left - 3H:1V
Right - 6H:1V
Crest Elevation (feet M.S.L.) - 1017.0
Gates - None
Downstream Channel - Flow would pass through a well vegetated area and into the downstream channel from the principal spillway.

At Right Abutment
Type - Vegetated trapezoidal earth channel
Length (feet) - 12
Base Width Perpendicular to Flow (feet) - 150
Side Slopes - Left - 3H:1V
Right - 3H:1V
Crest Elevation (feet M.S.L.) - 1017.0
Gates - None
Downstream Channel - Flow would pass through a wooded area and into a swamp downstream.

j. Regulatory Outlets (Principal Spillway) -

Lower Dam -

Type - Three-stage inlet riser and 54 inch reinforced concrete outlet pipe
Low-Level Orifice -
Invert Elevation (feet M.S.L.) - 1007.0
Opening Diameter (inches) - 54
Gate - 54 inch diameter Rodney Hunt slide gate
Second-Stage Orifices[2] -
Crest Elevation (feet M.S.L.) - 1010.0
Orifice Size - 5 feet wide by 3 feet high

[2]Two orifices, one on each side of the riser.

Gates - Two 5 foot wide by 3 foot high Rodney Hunt slide gates installed inverted for pool elevation control.

Third-Stage Overflow Weir -

Crest Elevation (feet M.S.L.) -	1014.0
Length (feet)[3] -	6.25
Vertical Clearance (feet) -	3.5

Outlet Pipe - A 54 inch (inner diameter) reinforced concrete pressure pipe supported on a concrete cradle. Three reinforced concrete anti-seep collars were provided on approximately 23 foot centers.

Riser Floor Invert Elevation (Outlet Conduit Entrance Invert - feet M.S.L.) -	1006.0
Outlet Conduit Exit Invert Elevation (feet M.S.L.) -	1005.5
Tailwater Sill Elevation (feet M.S.L.) -	1005.5

Downstream Channel - Sixteen feet base width with 3H:1V side slopes. The first 20 feet downstream is riprapped. The remainder of the channel is not riprapped. The channel is straight in plan to original streambed channel.

Upper Dam -

Type - Two-stage inlet riser and 54 inch reinforced concrete outlet pipe

Low-Level Orifice -

Invert Elevation (feet M.S.L.) -	1010.0
Opening Diameter (inches) -	54

Gate - 54 inch diameter Rodney Hunt slide gate

Second Stage Overflow Weir -

Crest Elevation (feet M.S.L.) -	1016.0
Length (feet)[4] -	6.25
Vertical Clearance (feet) -	3.5

Outlet Conduit - A 54 inch (inner diameter) reinforced concrete pressure pipe supported on a concrete cradle. Two reinforced concrete anti-seep collars were provided on approximately 20 foot centers.

Riser Floor Invert Elevation (Outlet Conduit Entrance Invert - feet M.S.L.) -	1009.0
Outlet Conduit Exit Invert Elevation (feet M.S.L.) -	1008.5

[3]Four chambers, each 6.25 feet long, are located on the riser (two on each side).

[4]Four chambers, each 6.25 feet long, are located on the riser (two on each side).

Tailwater Sill Elevation (feet M.S.L.) - 1008.5
Downstream Channel - Twelve feet base width with 3H:1V side slopes. The first 20 feet downstream is riprapped. The channel is straight in plan for the first 30 feet then curves to the right.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Upper and Lower Dams were designed for flood prevention and waterfowl habitat enhancement. They are two of eight proposed floodwater retarding dams in the Little Shenango River Watershed intended to reduce flood damages in the basin. They were designed to retard the 100-year frequency storm without any discharge occurring in the emergency spillway.

Upper and Lower Dams were designed by the SCS according to their standard procedures for structures of this type. Design data reviewed for this report included the following:

1) SCS Drawing Nos. PA 487A-P and B-P, "Little Shenango River Watershed, Multiple Purpose Dam PA 487A and B, Crawford and Mercer Counties, Pennsylvania, 43 sheets, 1972 ("as built" plans).

2) Design Report, "PA 487A and B, Little Shenango Watershed," Design Criteria, SCS, (copy in Pennsylvania Department of Environmental Resources' [PennDER] File No. 20-55), 1966.

3) Design Report, "Little Shenango River, PA 487A and B (revisions)," (copy in PennDER File No. 20-55), 1971.

4) "Little Shenango River Watershed, Work Plan," Crawford and Mercer Counties, Pennsylvania, 1963.

2.2 CONSTRUCTION

The construction of Upper and Lower Dams was performed by Milano Construction Company. The construction was completed in November 1973.

2.3 OPERATION

The operation of Upper and Lower Dams is the responsibility of the Pennsylvania Game Commission. No formal operation procedures or records are presently maintained. Historically, the reservoir level is fluctuated throughout the year to provide for waterfowl habitat enhancement.

2.4 EVALUATION

a. Availability - The information reviewed is readily available from the SCS office in Harrisburg, Pennsylvania and PennDER's File No. 20-55.

b. Adequacy - The information available is adequate for a Phase I inspection of these dams.

c. Validity - There is no reason at the present time to question the validity of the available information.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The visual inspections were performed on 14 May and 26 June 1980. There were no unusual weather conditions experienced during either inspection. Some heavy rainfall had occurred prior to the 14 May 1980 inspection date. The dams and appurtenant structures were found to be in good condition at the times of inspection. Noteworthy observations made during the visual inspections are described in the following paragraphs. The complete visual inspection checklist, field sketches, top of dam profiles, and typical cross-sections are presented in Appendix A.

b. Dam - The only observed, notable feature was some ponded water downstream from the toe of the right side of Lower Dam's embankment. This is felt to be the result of poor surficial drainage; however, it coincides with the location of the backfilled old streambed channel.

c. Appurtenant Structures - These structures were in good condition except for some chipped concrete (probably the result of vandalism) on the impact basin for Upper Dam.

d. Reservoir Area - No problems were observed in the reservoir areas.

e. Downstream Channel - Two houses, one barn, three garages, and one township road bridge are located approximately 2700 feet downstream of the Lower Dam. Upper and Lower Dams were built as part of the Little Shenango River Watershed plan to reduce floodwater damages primarily in Greenville, Pennsylvania.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The dams and appurtenances are inspected twice a year according to the operation and maintenance agreement for these dams (Standard SCS procedures).

4.2 MAINTENANCE OF DAMS

Routine maintenance is performed periodically by Pennsylvania Game Commission personnel on an as-needed basis (usually when the inspections determine maintenance is necessary or when during other routine visits to the dam, required maintenance is observed).

4.3 MAINTENANCE OF OPERATING FACILITIES

The gates are operated several times a year as part of the normal operating procedures for maintaining the reservoir at different levels for waterfowl enhancement. Maintenance of these facilities is performed by the Pennsylvania Game Commission.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There are no warning procedures to be followed in the event of an impending dam failure. An emergency warning procedure should be developed.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The condition and maintenance of the dams are considered good; however, it is recommended that formal records of the maintenance and gate operation be kept.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - Hydraulic and hydrologic design calculations for Upper and Lower Dams were obtained from the SCS design report for these dams. Lower Dam was designed to retard the 100-year flood without discharge occurring in the emergency spillways. Upper Dam was designed to maintain a pool for waterfowl habitat enhancement. When the reservoir level of Lower Dam rises to near the crest of the emergency spillways, Upper Dam is designed to be totally inundated. As such, the acting flood control structure during periods of high flows is Lower Dam.

The design high water and top of dam elevations were determined by routing the emergency spillways and freeboard hydrographs developed by the SCS through the reservoir. Both hydrographs were based on a storm duration of 6 hours. The freeboard hydrograph developed by the SCS is essentially equal to the Probable Maximum Flood (PMF). A summary of the rainfall and hydrograph data used in the design of the dam is included in Appendix D.

When the SCS prepared its watershed plan for the Little Shenango Watershed in 1963, construction of an additional dam (SCS No. PA 497) above Upper and Lower Dams was planned. This dam was to be located in approximately the same area that U.S. Route 322 crosses the watershed. With this dam in place, the uncontrolled drainage area above Upper and Lower Dams was 16.5 square miles. However, plans to build this additional dam were never implemented and, according to SCS personnel, there are no future plans to construct this dam. The drainage area calculations for Upper and Lower Dams were not appropriately revised. As a result, the drainage area used in the design of these dams is not correct; the correct drainage area is approximately 22.6 square miles. The affects of this increase in drainage area are discussed in the following sections.

b. Experience Data - The emergency spillways of Lower Dam have reportedly never been activated. No records of maximum pool levels are available.

c. Visual Observations - No conditions were observed during the visual inspection which would indicate that the dams and appurtenances could not perform satisfactorily during a flood event.

d. Overtopping Potential - Lower Dam is an "Intermediate" size -"High" hazard dam requiring evaluations for a spillway design flood (SDF) equal to the PMF. As was discussed in Section 5.1.a., Lower Dam was designed based on a freeboard hydrograph equal to the PMF. However, it was designed assuming that the uncontrolled drainage area above the dam would be decreased by the construction of an additional dam (SCS No. PA 497) in the upstream reaches of the watershed.

In order to determine if the dam can pass the required SDF with the added drainage area, the hydraulic capacity of the dam, reservoir, and spillways was reassessed by utilizing the U.S. Army Corps of Engineers Flood Hydrograph Package, HEC-1 DB. The hydrologic characteristics of the watershed, specifically, the Snyder's unit hydrograph parameters, were obtained from a regionalized analysis conducted by the Baltimore District of the U.S. Army Corps of Engineers. The watershed was divided into five separate subbasins in order to accurately s mulate the hydrologic and hydraulic responses of the watershed (see Appendix D).

This analysis indicated that, even with the additional drainage area, Lower Dam is capable of passing the PMF without overtopping the dam.

e. Spillway Adequacy - As outlined above, Lower Dam is capable of passing the PMF without overtopping the dam. Therefore, the spillways are considered to be "adequate."

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - No evidence of embankment distress or instability was observed during the inspections. Moisture observed below the right downstream toe of Lower Dam is considered to be the result of poor surficial drainage. However, this area coincides with the location of the former streambed channel and should be visually examined in future inspections.

b. Design and Construction Data - Calculations of embankment slope and foundation stability were not available for review. However, a summary report from the SCS Soil Mechanics Laboratory in Lincoln, Nebraska, dated 21 and 24 January 1966, presented the results of the laboratory soil testing program and slope stability analyses. Laboratory stability charts were used for the estimation of the factor of safety for a 15 foot high dam (SCS Site No. 487A or the Lower Dam). (Note: the maximum section of the dam is 20 feet.) Total stress shear strength parameters of ϕ = 29° and c = 300 pounds per square foot (p.s.f.) [sandy silt (ML) material] were used for the embankment. A six foot layer of alluvial silt (ML) was used for the foundation with estimated parameters of ϕ = 10° and c = 250 p.s.f.

The stability charts indicated that a 3H:1V upstream slope under full drawdown conditions would have a factor of safety of 1.60 and a factor of safety of 1.74 for a 3H:1V downstream slope with a drain at c/b = 0.5 (or at a distance of 0.5 times the base length of the downstream slope downstream from the vertical plane of the downstream edge of the crest of the dam). According to the "as built" plans, the drain was placed slightly upstream of this point and the embankment is higher than the anticipated 15 feet. It is estimated that these changes do not significantly affect the factor of safety from those reported. Based upon the above estimations for Lower Dam, it is concluded that for Upper Dam, with similar materials and a lower embankment than Lower Dam, the factors of safety should be greater than Lower Dam.

Based upon the above information, coupled with the visual inspection, it is concluded that further

stability assessments of the embankments are not necessary.

c. Operating Records - Nothing in the available operating information indicates cause for concern relative to the structural stability of the dams.

d. Post-Construction Changes - No changes adversely affecting the structural stability of the dams have been performed.

e. Seismic Stability - The dams are located in Seismic Zone 1 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of minor seismic activity. Therefore, further consideration of the seismic stability is not warranted.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - The dams and their appurtenant structures were found to be in good overall condition at the time of inspection. Lower Dam is an "Intermediate" size - "High" hazard dam requiring evaluation for an SDF equivalent to the PMF. As discussed in Section 5, the spillways and reservoir were determined to be of sufficient size to safely pass the SDF without overtopping the dam. The spillways are therefore considered to be "adequate."

b. Adequacy of Information - The information available is considered to be adequate for a Phase I Inspection Report.

c. Urgency - No urgent remedial work is required. The owners of the dams should immediately undertake the minor repair item described in paragraph 7.2.

d. Necessity for Additional Data/Evaluation - No conditions were observed during the inspection of these dams which would warrant additional evaluation at this time.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection revealed only one deficiency which should be corrected immediately, namely, the repair of the chipped concrete on the impact basin of Upper Dam.

It is recommended that the wet areas below the right side toe of Lower Dam's embankment be visually examined in future inspections and the condition recorded.

In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, the

owner should activate the emergency operation and warning system.

It is also recommended that the maintenance and operations be recorded and these records maintained for future reference should it become necessary.

APPENDIX A

VISUAL INSPECTION CHECK LIST, FIELD SKETCH, TOP OF DAM PROFILE, AND TYPICAL CROSS-SECTION

Phase 1
Visual Inspection
Check List

Name of Dam Upper and Lower Dams County Crawford State PA

NDI # PA 00389
PennDER # 20-55
SCS # PA 487 A and B

Lower Dam Coordinates Lat. N 41°31.3'
Long. W 80°21.7'

Upper Dam Coordinates Lat. N 41°32.2'
Long. W 80°22.0'

Date of Inspection 14 May 1980 and 26 June 1980

Weather Overcast / Sunny

Temperature 50° F. / 80° F.

Pool Elevation at Time of Inspection ____ M.S.L.
Lower Dam (26 June 1980) 1011.9 ft.
Upper Dam (26 June 1980) 1016.1 ft.

Tailwater at Time of Inspection ____ M.S.L.
1005.7 ft.
1013.5 ft.

Inspection Personnel:

Michael Baker, Jr., Inc.:

14 May 1980

James G. Ulinski
Wayne D. Lasch
Terry S. Hawk

26 June 1980

James G. Ulinski
Wayne D. Lasch
Clifford E. Guindon

Owner's Representatives:

George Palahunik,
Waterfowl Assistant Manager,
Pennsylvania Game Commission

Field Review - 10 June 1980:

John A. Dziubek
James G. Ulinski

James G. Ulinski Recorder

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: UPPER AND LOWER DAMS

NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		
DRAINS		
WATER PASSAGES		
FOUNDATION		

CONCRETE/MASONRY DAMS - Not Applicable

Name of Dam: UPPER AND LOWER DAMS

NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		

EMBANKMENT - LOWER DAM

Name of Dam UPPER AND LOWER DAMS

NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed	

EMBANKMENT - LOWER DAM

Name of Dam UPPER AND LOWER DAMS

NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No problems were observed.	
RIPRAP FAILURES	The upstream slope is protected with riprap; no problems were observed.	

EMBANKMENT - LOWER DAM

Name of Dam UPPER AND LOWER DAMS

NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The right abutment of the right emergency spillway has several animal burrows; however, these do not present a problem.	
ANY NOTICEABLE SEEPAGE	A wet area was observed below the toe of the dam on the right side. This area is considered to be the result of poor surficial drainage; however, it does coincide with the location of the original streambed.	This area should be visually examined in future inspections and the condition recorded.
STAFF GAGE AND RECORDER	None	
DRAINS	The right drain was flowing with a minor amount (approximately 1 g.p.m.) of flow. No problems were observed.	

EMBANKMENT - UPPER DAM

Name of Dam *UPPER AND LOWER DAMS*

NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed	

EMBANKMENT - UPPER DAM

Name of Dam UPPER AND LOWER DAMS
NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No problems were observed.	
RIPRAP FAILURES	The upstream slope of the embankment at the location of the principal spillway is protected with riprap. The embankment to the right of the principal spillway is protected on both the upstream and downstream faces. No problems were observed.	

EMBANKMENT - UPPER DAM

Name of Dam UPPER AND LOWER DAMS

NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems were observed.	
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

PRINCIPAL SPILLWAY - LOWER DAM

Name of Dam: UPPER AND LOWER DAMS
NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The inside condition of the conduit could not be examined because of the volume of water discharging from the conduit.	
INTAKE STRUCTURE	The intake structure was in good condition; no problems were observed.	
OUTLET STRUCTURE	The outlet structure was in good condition; no problems were observed.	
OUTLET CHANNEL	Some minor erosion has occurred downstream of the impact basin.	This erosion is not considered a significant problem. It should be observed in the future to determine if riprap will become necessary.
EMERGENCY GATE	There are 3 gates on this structure, one 54 in. diameter gate on the front side of the riser unit and two (one on the left and one on the right side of the riser unit) 60 in. by 36 in. slide gates on the upstream half of the riser unit. The two gates on the sides of the riser unit were installed inverted in order to control the pool according to the requirements for waterfowl enhancement. The gates are operated several times a year and no problems were observed.	

PRINCIPAL SPILLWAY - UPPER DAM

Name of Dam: UPPER AND LOWER DAMS

NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet conduit was submerged by back water from Lower Dam's pool and could not be examined.	
INTAKE STRUCTURE	No problems were observed.	
OUTLET STRUCTURE	Some minor areas were observed where the concrete was chipped. This is apparently the result of vandalism.	These areas of the concrete should be repaired.
OUTLET CHANNEL	No problems observed	
EMERGENCY GATE	The 54 in. diameter gate is operated several times a year. No problems were observed.	

EMERGENCY SPILLWAYS - LOWER DAM

Name of Dam: UPPER AND LOWER DAMS
NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTION	No problems observed	
APPROACH CHANNEL	No problems observed	
DISCHARGE CHANNEL	No problems observed	
BRIDGE AND PIERS	None	

EMERGENCY SPILLWAYS - UPPER SPILLWAY

Name of Dam: UPPER AND LOWER DAMS
NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTION	No problems observed	
APPROACH CHANNEL	No problems observed	
DISCHARGE CHANNEL	No problems observed	
BRIDGE AND PIERS	None	

GATED SPILLWAY - Not Applicable

Name of Dam: UPPER AND LOWER DAMS
NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

INSTRUMENTATION - None

Name of Dam: UPPER AND LOWER DAMS
NDI # PA 00389

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS		
OBSERVATION WELLS		
WEIRS		
PIEZOMETERS		
OTHER		

RESERVOIR - LOWER DAM

Name of Dam: UPPER AND LOWER DAMS
NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	A railroad embankment forms the right side of the reservoir and farmland with undulating glacial moraines are located to the left. The entire region is relatively flat.	
SEDIMENTATION	The owners' representative indicated that sedimentation is not a problem.	

RESERVOIR - UPPER DAM

Name of Dam: UPPER AND LOWER DAMS

NDI # PA 00389

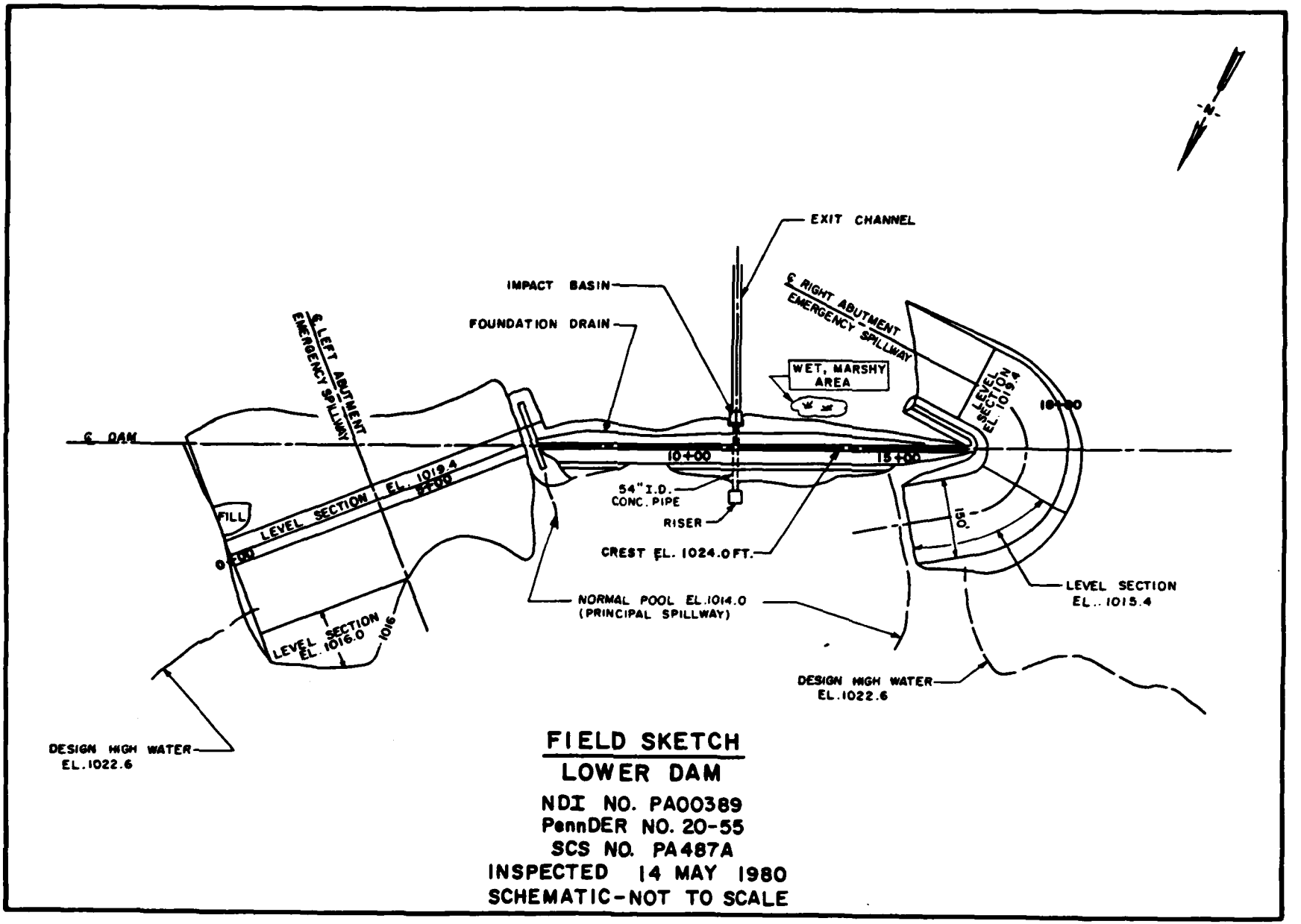
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The area is flat with some glacial moraines to the left of the reservoir and a railroad embankment to the right.	
SEDIMENTATION	The owners' representative indicated that sedimentation is not a problem.	

DOWNSTREAM CHANNEL - LOWER DAM

Name of Dam: UPPER AND LOWER DAMS

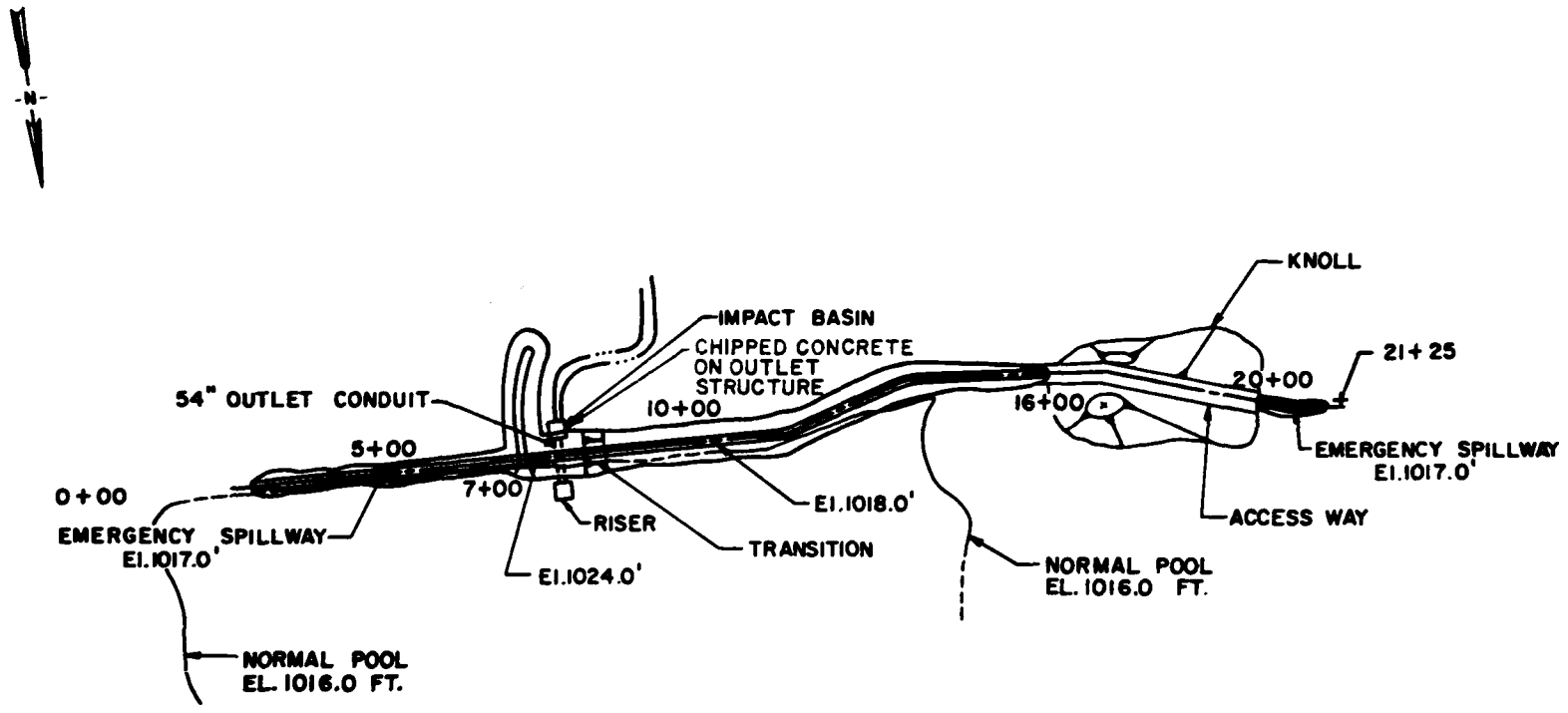
NDI # PA 00389

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is free of obstructions and debris.	
SLOPES	The side slopes of the channel are relatively flat. The slope of the channel is mild.	
APPROXIMATE NO. OF HOMES AND POPULATION	This project was part of the Little Shenango River Watershed plan to reduce floodwater damages primarily in Greenville, PA. There are 2 houses, 3 garages, 1 barn, and one bridge which are located approximately 2700 ft. downstream from the dam on the upstream side of a township road.	



FIELD SKETCH
LOWER DAM

NDI NO. PA00389
PennDER NO. 20-55
SCS NO. PA487A
INSPECTED 14 MAY 1980
SCHEMATIC-NOT TO SCALE



FIELD SKETCH

UPPER DAM

NDI NO. PA00389
PennDER NO. 20-55
SCS NO. PA487B
INSPECTED 26 JUNE 1980
SCHEMATIC-NOT TO SCALE

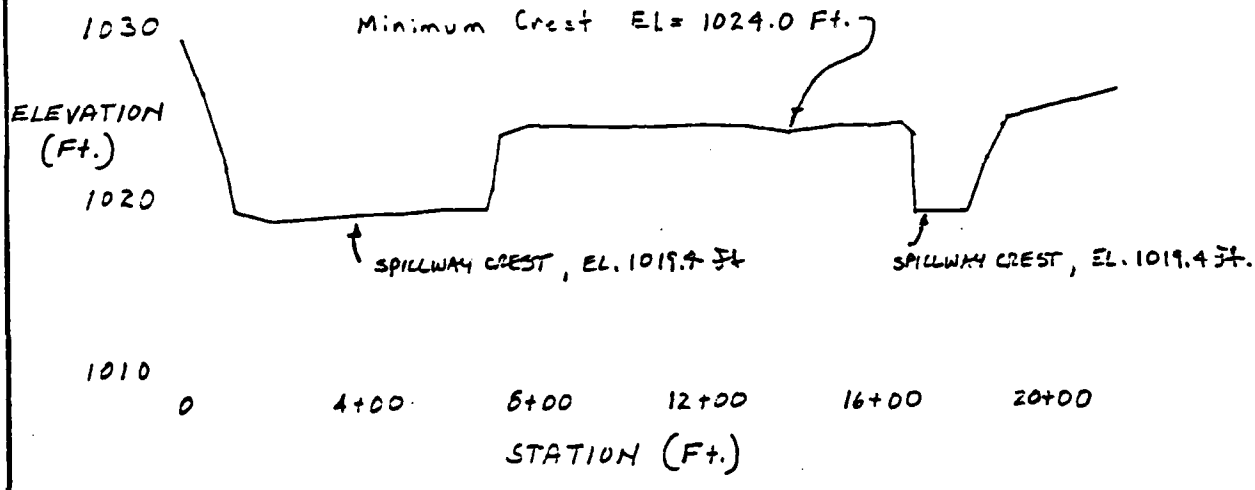
MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
30 July 1980
Box 280
Beaver, Pa. 15009

LOWER DAM

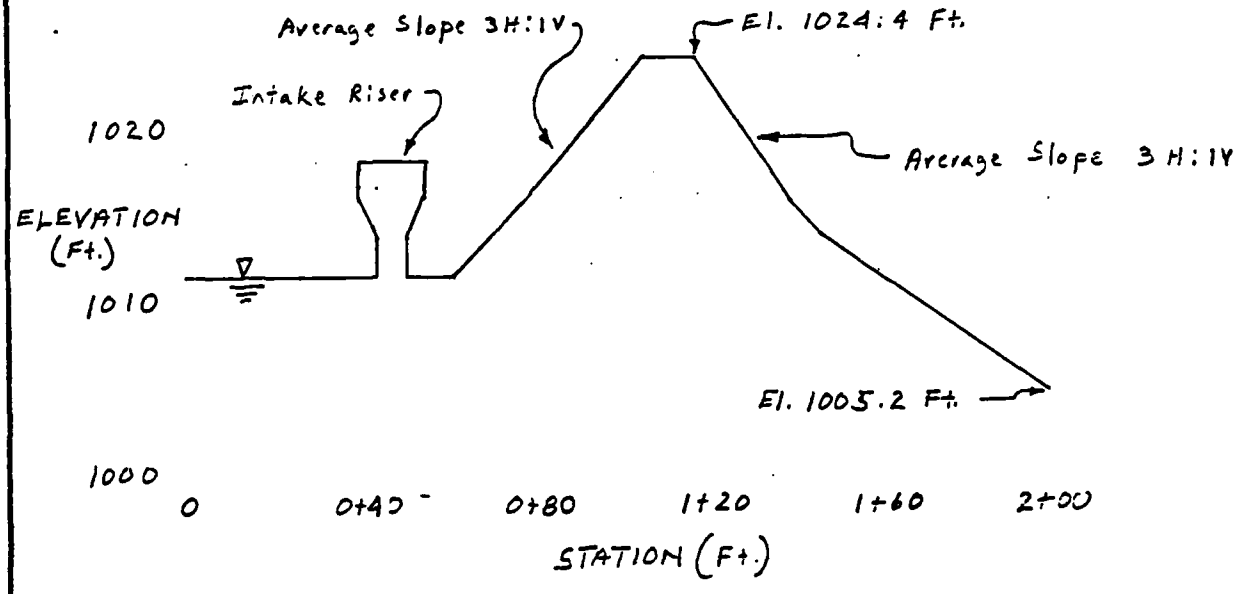
TOP OF DAM PROFILE
TYPICAL CROSS-SECTION

DATES OF INSPECTION - 14 May 1980
and 26 June 1980

TOP OF DAM PROFILE



CROSS SECTION AT STA. 11+02

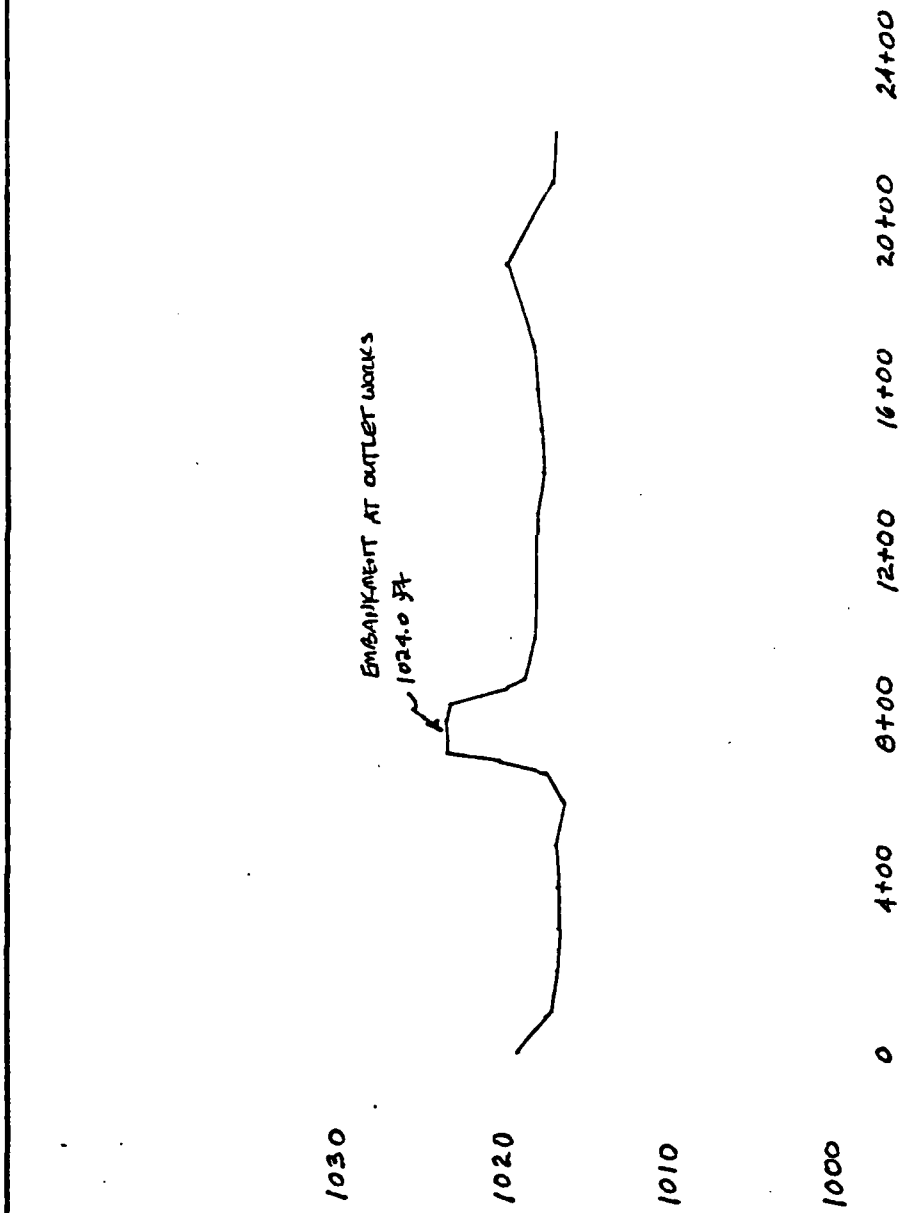


MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
30 July 1980
Box 280
Beaver, Pa. 15009

UPPER DAM

TOP OF DAM PROFILE

DATES OF INSPECTION - 14 May 1980
and 26 June 1980



APPENDIX B

ENGINEERING DATA CHECK LIST

ENGINEERING DATA
CHECK LIST
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: UPPER AND LOWER DAMS
NDI # PA 00389

ITEM	REMARKS
PLAN OF DAM	See Plates 3 (Lower Dam) and 9 (Upper Dam) of this report.
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	The dams were designed by the SCS. Construction of the dams by Milano Construction Company was completed in November 1973.
TYPICAL SECTIONS OF DAM	See Plates 4, 5, and 6 (Lower Dam); 10, 11, and 13 (Upper Dam).
HYDROLOGIC/HYDRAULIC DATA	Design computations from the SCS design report (plus revisions) for SCS # PA 487 A and B were reviewed for this report. These computations are summarized in Section 5 and Appendix D.
PRINCIPAL SPILLWAY OUTLETS - PLAN	See Plates 3 (Lower Dam) and 9 (Upper Dam).
- DETAILS and CONSTRAINTS	See Plates 6, 7, and 8 (Lower Dam); 13, 14, and 15 (Upper Dam).
- DISCHARGE RATINGS	Discharge ratings were included in the SCS design report for this dam and are summarized in Appendix D.
RAINFALL/RESERVOIR RECORDS	None available

ITEM	REMARKS
DESIGN REPORTS	The SCS design reports (and revisions) for SCS # PA 487 A and B are available from the Harrisburg, PA SCS office and PennDER File # 20-55.
GEOLOGY REPORTS	The regional geology is summarized in Appendix F. For a detailed report of the site geology, see the SCS design folder for these dams.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	These analyses are contained in the SCS design folder for these dams.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	The results of the foundation and borrow excavation borings, test pits, and tests are contained on the design drawings and design folder for these dams.
POST-CONSTRUCTION SURVEYS OF DAM	An "as built" survey was performed to prepare the "as built" plans.
BORROW SOURCES	The majority of the borrow material used for the construction of the embankments was taken from the necessary excavation of the emergency spillways. It is not certain whether additional borrow was required.

Name of Dam: UPPER AND LOWER DAMS
NDI # PA 00389

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	None available
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	The dams are inspected twice a year according to standard procedures for SCS dams of this type.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	Maintenance and operation records are kept in accordance with the operation and maintenance agreement. These records consist of the twice a year inspection reports.

Name of Dam: UPPER AND LOWER DAMS
NDI # PA 00389

ITEM	REMARKS
(EMERGENCY) SPILLWAY PLAN	See Plates 3 (Lower Dam) and 9 (Upper Dam).
- SECTIONS and DETAILS	See Plates 5 (Lower Dam) and 11 (Upper Dam).
OPERATING EQUIPMENT PLANS & DETAILS	Plates 6 and 7 (Lower Dam) and 13 and 14 (Upper Dam) shows the location of the Rodney Hunt gates for these dams. Construction notes are provided on Sheet 26 of 43 of the "as built" plans.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA
LOWER DAM

DRAINAGE AREA CHARACTERISTICS: 22.6 sq.mi. (primarily rural and agricultural land)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1014.0 ft. M.S.L. (850 ac.-ft.)
(PRINCIPAL SPILLWAY)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1024.0 ft. M.S.L. (7810 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: 1022.6 ft. M.S.L.

ELEVATION TOP DAM: 1024.0 ft. M.S.L.

SPILLWAY: Emergency spillways on left and right abutments

a. Crest Elevation 1019.4 ft. M.S.L.
b. Type Vegetated earth trapezoidal channel
c. Bottom Width of Channel Left spillway - 600 ft.
Right spillway - 150 ft.
d. Length of Spillway Along Centerline (Parallel to Flow)
Left spillway - 400 ft. - Right spillway - 625 ft.
e. Location Spillover Left abutment and right abutment
f. Number and Type of Gates None

OUTLET WORKS: Drop-inlet concrete riser and outlet conduit (principal spillway)

a. Type 54 in. diameter reinforced concrete pipe
b. Location Approximately 990 ft. from left abutment
c. Entrance Inverts 1014.0 ft. M.S.L. (overflow weir)
d. Exit Inverts 1005.5 ft. M.S.L.
e. Emergency Drawdown Facilities 1) 54 in. dia. slide gate at El. 1007 ft. M.S.L. on upstream side of concrete riser.
2) Two 5 ft. long by 3 ft. wide inverted slide gates, invert El. 1010.0 ft. M.S.L.

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE No records available

APPENDIX C

PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam

Top Photo - (OV-T) Overall View of Lower Dam from Right End of Embankment

Bottom Photo - (OV-B) Overall View of Downstream Slope of Lower Dam from Right End of Embankment

Photograph Location Plans

Photo 1 - Overall View of Lower Dam and Left Emergency Spillway from Left Abutment (Parking Lot)

Photo 2 - View across Left Emergency Spillway of Lower Dam Looking at Left Abutment

Photo 3 - View of Entrance to Right Emergency Spillway of Lower Dam

Photo 4 - View from Entrance to Right Emergency Spillway of Lower Dam Looking Downstream

Photo 5 - View of Intake of Principal Spillway of Lower Dam

Photo 6 - View of Outlet Structure of Principal Spillway of Lower Dam

Photo 7 - View of Emergency Spillway of Upper Dam Looking toward Dam

Photo 8 - View of Emergency Spillway of Upper Dam Looking toward Left Abutment

Photo 9 - View of Intake Structure of Principal Spillway of Upper Dam

Photo 10 - View of Outlet Structure of Principal Spillway of Upper Dam

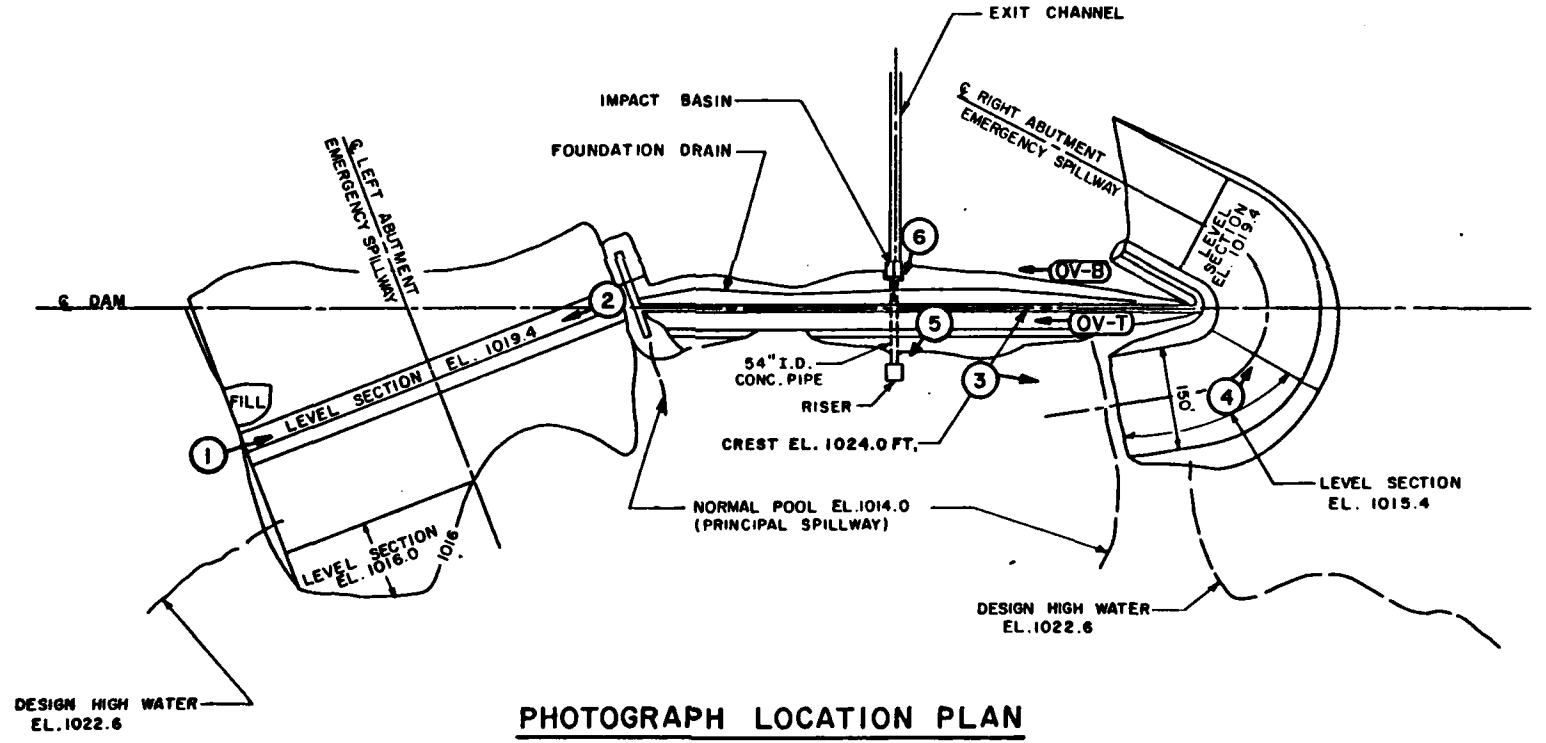
Photo 11 - View of Embankment of Upper Dam from Principal Spillway Location

Photo 12 - View of Embankment of Upper Dam from Right End of Embankment (Note: Near the insitu small knoll)

Photo 13 - View of Upstream Face of Road Embankment (Route 322) in Upstream Portion of Watershed

Photo 14 - View of Downstream End of Culvert under Route 322

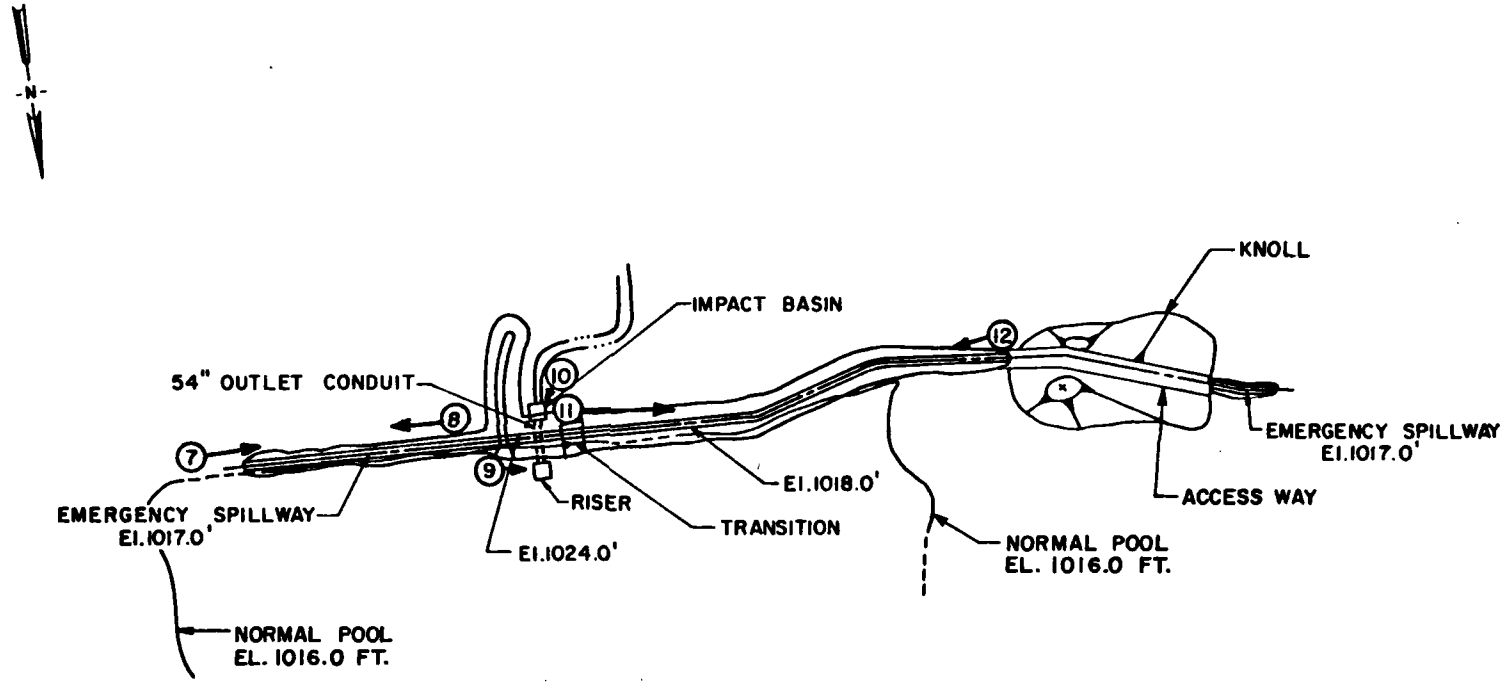
Note: Photographs 7 through 12 were taken on 26 June 1980.
All other photographs were taken on 14 May 1980.



PHOTOGRAPH LOCATION PLAN

LOWER DAM PHOTO PLAN

NDI NO. PA00389
PennDER NO. 20-55
SCS NO. PA487A
Photographs Taken on 14 May 1980



PHOTOGRAPH LOCATION PLAN

UPPER DAM PHOTO PLAN

NDI NO. PA00389
PennDER NO. 20-55
SCS NO. PA487B
Photographs Taken on 26 June 1980

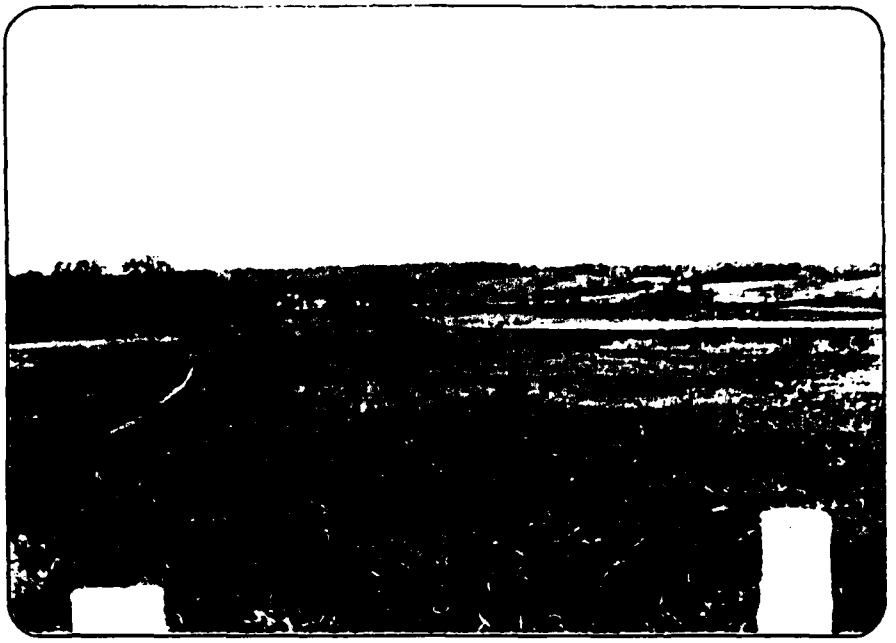


PHOTO 1. Overall View of Lower Dam and Left Emergency Spillway from Left Abutment (Parking Lot)

PHOTO 2. View across Left Emergency Spillway of Lower Dam Looking at Left Abutment

PHOTO 3. View of Entrance to Right Emergency Spillway of Lower Dam

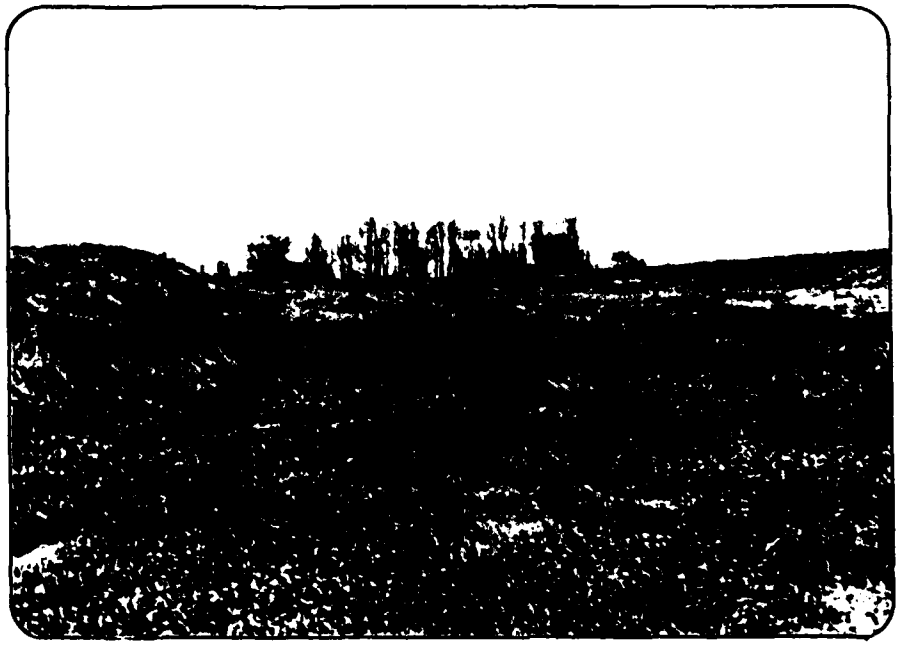


PHOTO 4. View from Entrance to Right Emergency Spillway of Lower Dam Looking Downstream

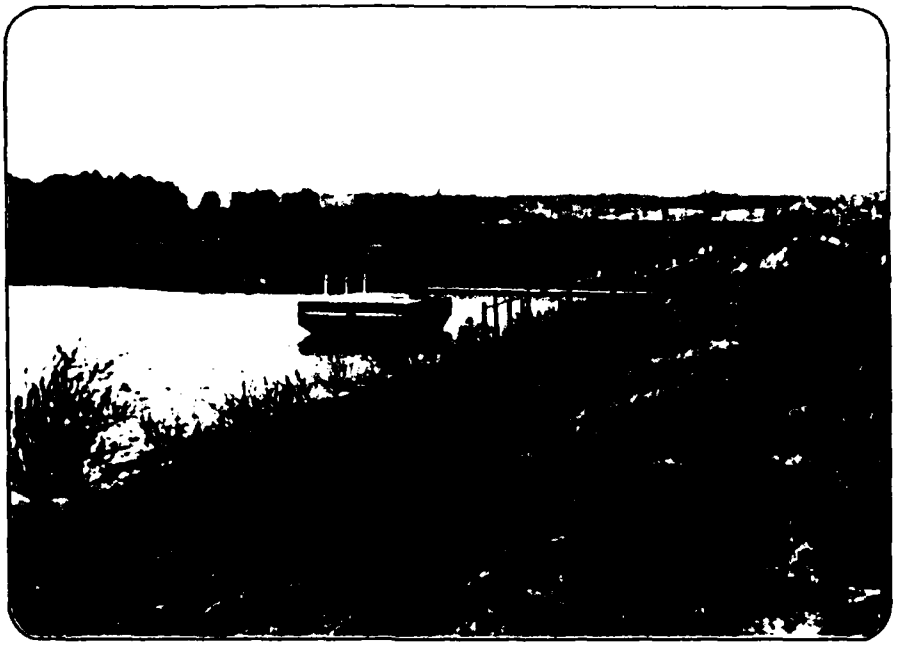


PHOTO 5. View of Intake of Principal Spillway of Lower Dam

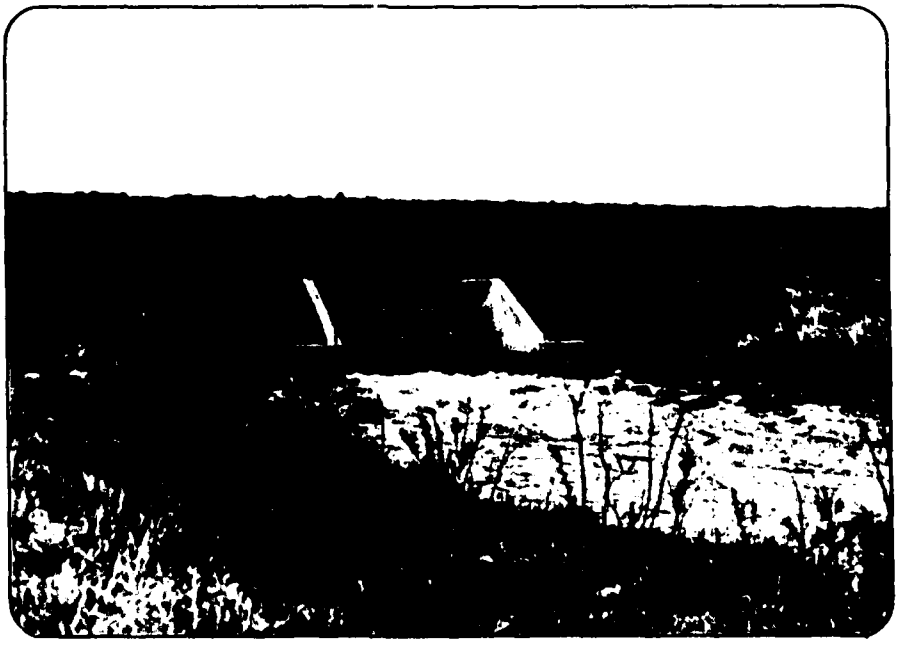


PHOTO 6. View of Outlet Structure of Principal Spillway of Lower Dam

PHOTO 7. View of Emergency Spillway of Upper Dam Looking toward Dam

PHOTO 8. View of Emergency Spillway of Upper Dam
Looking toward Left Abutment

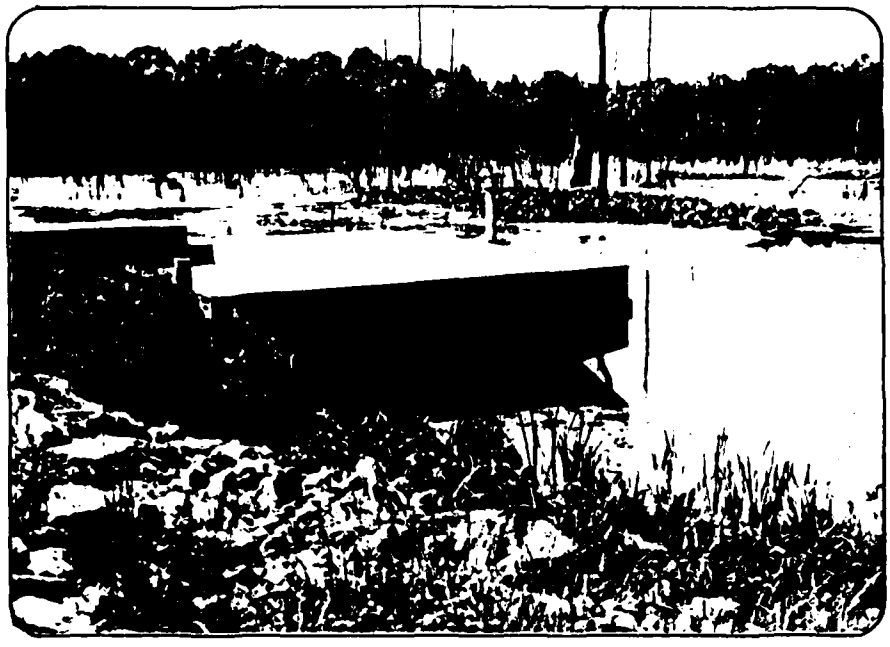


PHOTO 9. View of Intake Structure at Principal Spillway of Upper Dam

PHOTO 10. View of Outlet Structure of Principal Spillway of Upper Dam

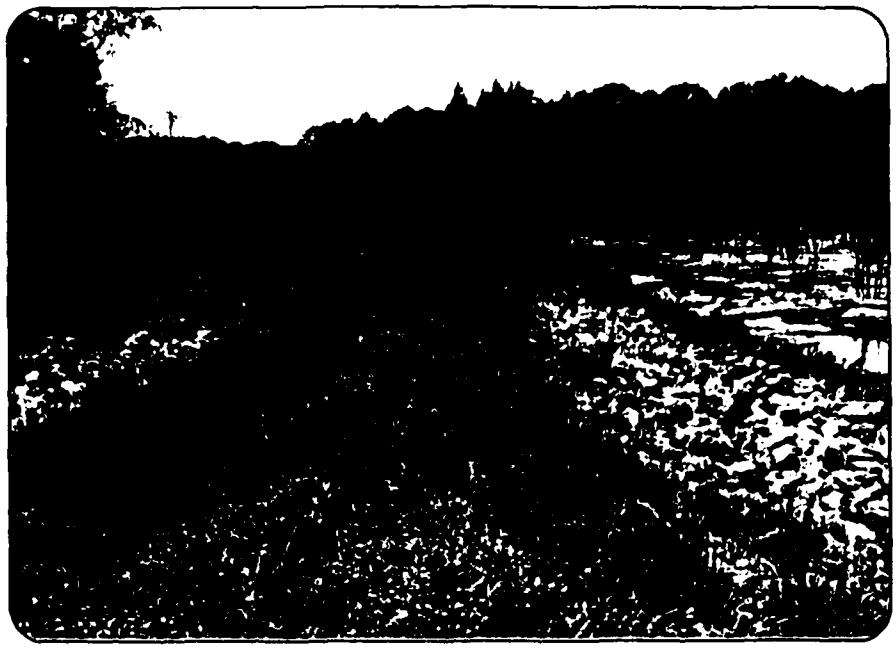


PHOTO 11. View of Embankment of Upper Dam from Principal Spillway

PHOTO 12. View of Embankment of Upper Dam from Right End of Embankment

PHOTO 13. View of Upstream Face of Road Embankment (Route 322) in Upstream Portion of Watershed

PHOTO 14. View of Downstream End of Culvert under Route 322

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject UPPER AND LOWER DAMS S.O. No.
HYDROLOGIC AND HYDRAULIC Sheet No. of
DATA Drawing No.
Computed by LAD Checked by Date 2/1/80

TABLE OF CONTENTS

PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic determinations presented in this Phase I Inspection Report are based on the use of a Snyder's unit hydrograph developed by the U.S. Army Corps of Engineers. Due to the limited number of gaging stations available in this hydrologic region and the wide variations of watershed slopes, the Snyder's coefficients may yield results of limited accuracy for this watershed. As directed however, a further refinement of these coefficients is beyond the scope of this Phase I Investigation.

In addition, the conclusions presented pertain to present conditions, and the effect of future development on the hydrology has not been considered.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: UPPER AND LOWER DAMS

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.3 INCHES/24 HOURS[1]

STATION	1	2	3	4	5
Station Description (Total drainage basin divided into subbasins as shown on sheet 2)	Subbasin 1	Subbasin 2	Subbasin 3	Subbasin 4	Subbasin 5
Drainage Area (square miles)	7.43	2.36	3.48	2.09	7.24
Cumulative Drainage Area (square miles)	22.6				
Adjustment of PMF for Drainage Area (%)[2]	Zone 2				
6 Hours	117	(Zone and PMF adjustment identical for all subbasins)			
12 Hours	127				
24 Hours	141				
48 Hours	151				
72 Hours	-				
Snyder Hydrograph Parameters					
Zone [3]	27	(Zone, C_p, and C_t identical for all subbasins)			
C_p/C_t [4]	0.40/2.7				
L (miles) [5]	6.02	3.50	4.32	2.94	5.80
L_{ca} (miles)[5]	3.52	1.93	2.42	1.53	2.80
$t_p = C_t (L \cdot L_{ca})^{0.3}$ (hours)	6.75	4.79	5.46	4.24	6.23
Spillway Data					
Crest Length (ft)	(Spillway rating curve shown on sheet 10)				
Freeboard (ft)					
Discharge Coefficient					
Exponent					

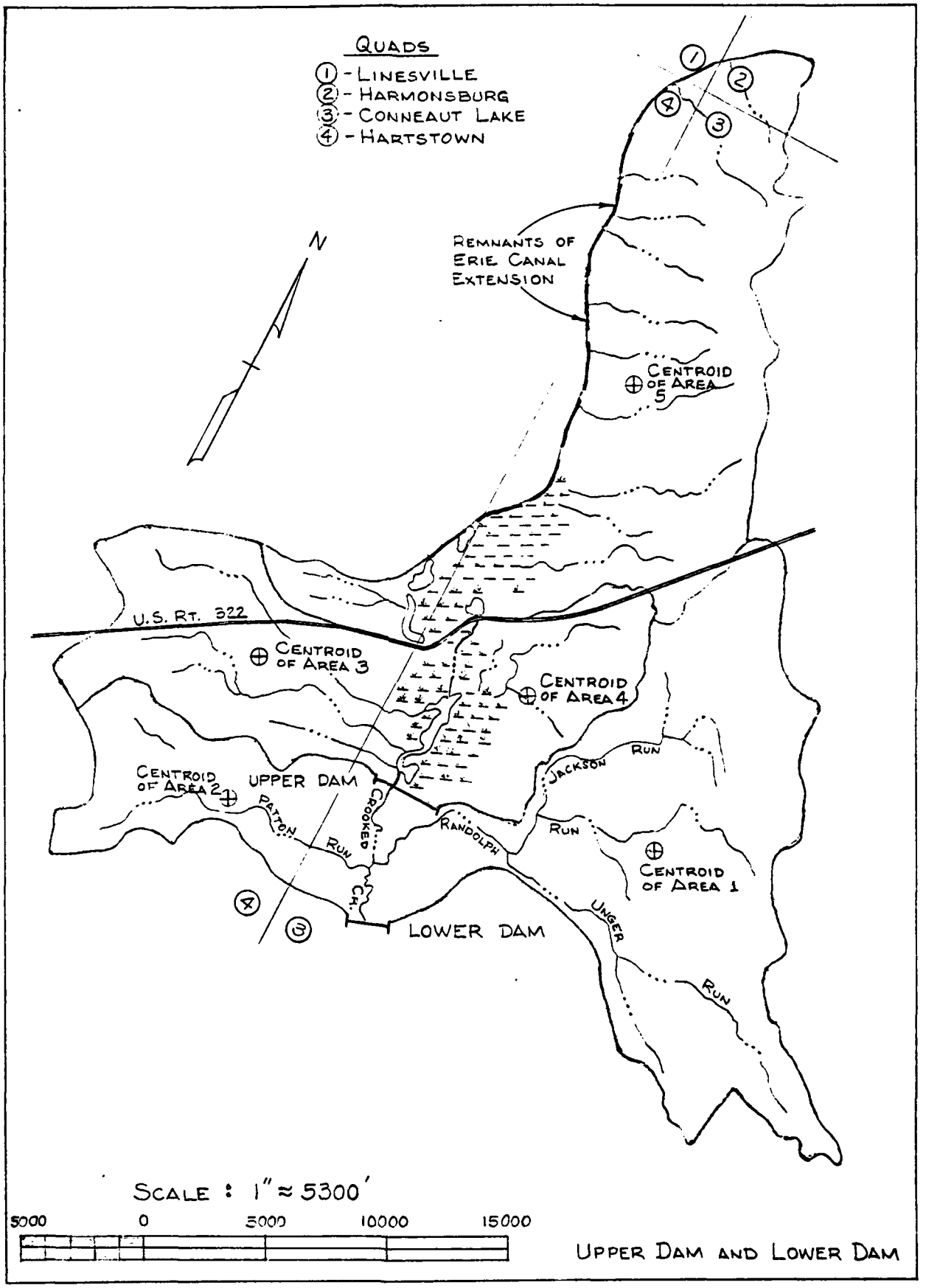
[1] Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

[2] Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

[3] Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

[4] Snyder's Coefficients.

[5] L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.



UPPER DAM AND LOWER DAM

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject UPPER & LOWER DAMS S.O. No.
HYDRAULIC DATA Sheet No. 3 of 23
Drawing No.
Computed by WLS Checked by WDL Date

DRAINAGE AREA (1)

DRAINAGE AREA = 7.43 SQ. MI. (MEASURED ON CONNEAUT LAKE, PA. QUAD)

LONGEST HYDRAULIC PATH TO DAM = 31,800' = 6.02 MI. (MEASURED FROM EASTERN MOST POINT OF DRAINAGE AREA)

DISTANCE FROM CENTROID TO DAM = 18,600' = 3.52 M.

SNYDERS UNIT HYDROGRAPH COEFFICIENTS

ZONE NO. 27

$C_p = 0.40$

$C_T = 2.7$ (PLATE O)

$T_p = C_T (L \times L_{CA})^{0.3}$

$= 2.7(6.02 \times 3.52)^{0.3} = 6.75$ HOURS

DRAINAGE AREA (2)

DRAINAGE AREA = 2.36 SQ. MI. (MEASURED ON CONNEAUT LAKE AND HARTSTOWN, PA. QUADS)

LONGEST HYDRAULIC PATH TO DAM = 18,500' = 3.50 MI. (MEASURED FROM WESTERN MOST POINT OF DRAINAGE AREA)

DISTANCE FROM CENTROID TO DAM = 10,200' = 1.93 MI.

SNYDERS UNIT HYDROGRAPH COEFFICIENTS

ZONE NUMBER 27

$C_p = 0.40$

$C_T = 2.7$ (PLATE O)

$T_p = C_T (L \times L_{CA})^{0.3}$

$= 2.7 (3.50 \times 1.93)^{0.3} = 4.79$ HOURS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
Box 280
Beaver, Pa. 15009

Subject UPPER AND LOWER DAMS S.O. No. _____
HYDRAULIC DATA Sheet No. 4 of 23
Drawing No. _____
Computed by WLS Checked by WDL Date _____

DRAINAGE AREA ③

DRAINAGE AREA = 3.48 SQ. MI. (MEASURED ON CONNEAUT LAKE AND HARTSTOWN, PA QUADS)

LONGEST HYDRAULIC PATH TO DAM = 22,800' = 4.32 MI. (MEASURED FROM WESTERN MOST POINT OF DRAINAGE AREA)

DISTANCE FROM CENTROID TO DAM = 12,800' = 2.42 MI.

SNYDERS UNIT HYDROGRAPH COEFFICIENTS

ZONE NUMBER 27

$C_p = 0.40$

$C_T = 2.7$ (PLATE O)

$T_p = C_T (L \times L_{CA})^{0.3}$

$= 2.7(4.32 \times 2.42)^{0.3} = 5.46$ HOURS

DRAINAGE AREA ④

DRAINAGE AREA = 2.09 SQ. MI. (MEASURED ON CONNEAUT LAKE, PA. QUAD)

LONGEST HYDRAULIC PATH TO DAM = 15,500' = 2.94 MI. (MEASURED FROM NORTHERN MOST POINT OF DRAINAGE AREA)

DISTANCE FROM CENTROID TO DAM = 8,100' = 1.53 MI.

SNYDERS UNIT HYDROGRAPH COEFFICIENTS

ZONE NUMBER 27

$C_p = 0.40$

$C_T = 2.7$ (PLATE O)

$T_p = C_T (L \times L_{CA})^{0.3}$

$= 2.7(2.94 \times 1.53)^{0.3} = 4.24$ HOURS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
Box 280
Beaver, Pa. 15009

Subject UPPER AND LOWER DAMS S.O. No.
HYDRAULIC DATA Sheet No. 5 of 23
Drawing No.
Computed by WLS Checked by WDC Date

DRAINAGE AREA (5)

DRAINAGE AREA = 7.24 SQ. MI. (MEASURED ON CONNEAUT LAKE, HARTSTOWN, HARMONSBURG, & LINESVILLE PA QUADS)

LONGEST HYDRAULIC PATH TO DAM = 30,600' = 5.80 MI. (MEASURED ALONG LINE SHOWN ON QUAD)

DISTANCE FROM CENTROID TO DAM = 14,800' = 2.80 MI. (MEASURED ALONG LINE SHOWN ON QUAD)

SNYDERS UNIT HYDROGRAPH COEFFICIENTS

ZONE NUMBER 27

$C_P = 0.40$

$C_T = 2.7$ (PLATE O)

$T_P = C_T (L \times L_{CA})^{0.3}$

$= 2.7 (5.80 \times 2.80)^{0.3} = 6.23$ HOURS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

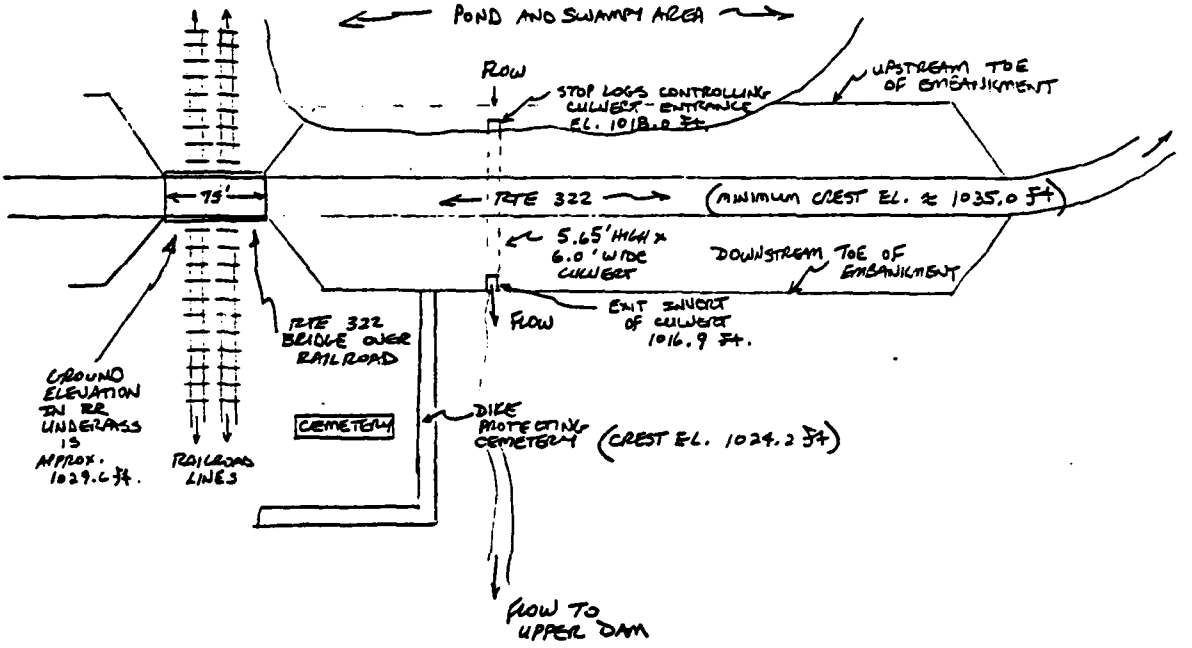
Subject DATA FOR CULVERT UNDER RTE 322 S.O. No.

Sheet No. 6 of 23

Drawing No.

Computed by WDL Checked by LAD Date 7-30-80

PLAN VIEW OF CULVERT (NOT TO SCALE)



STORAGE INFORMATION FOR AREA ABOVE RTE. 322

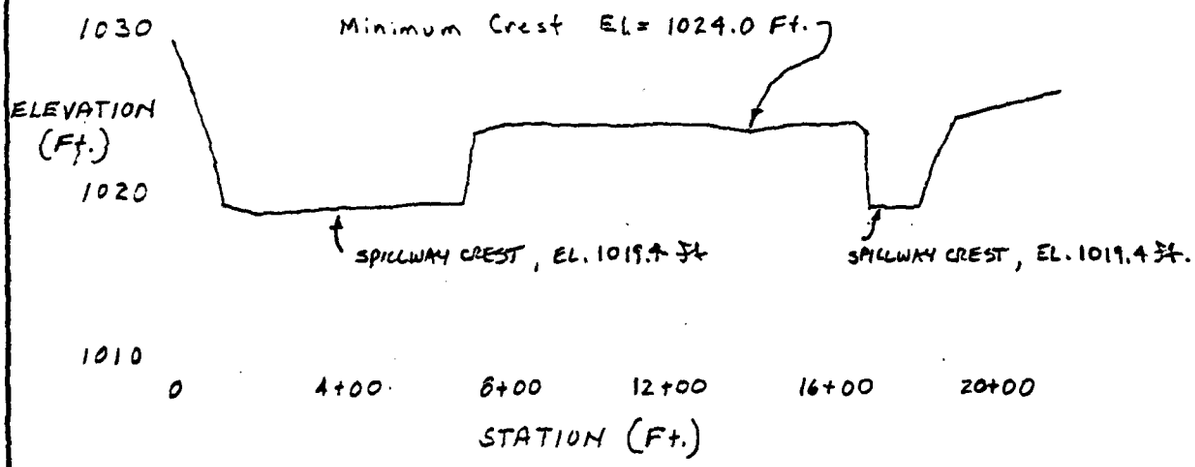
ELEVATION, Ft.	SURFACE AREA, Ac.
1010.0	46.1
1020.0	372.5
1030.0	535.7

AREAS MEASURED ON USGS QUADS FOR THIS AREA

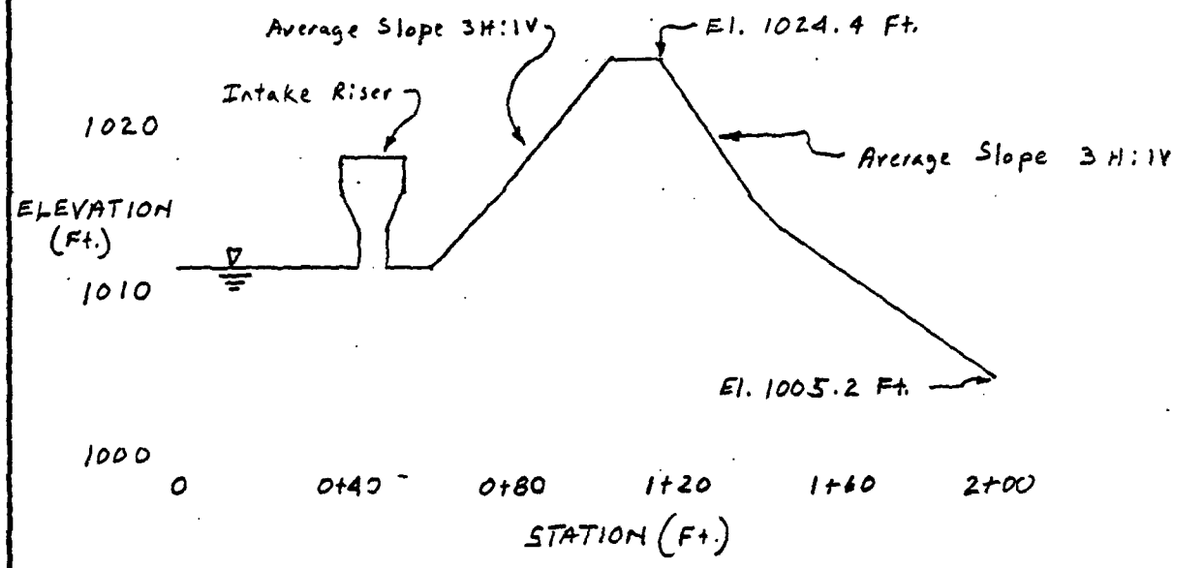
MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS
Box 280
Beaver, Pa. 15009

Subject LOWER DAM S.O. No.
TOP + DAM PROFILE AND Sheet No. 7 of 23
DAM CROSS SECTION Drawing No.
Computed by LAD Checked by Date 7/20/80

TOP OF DAM PROFILE



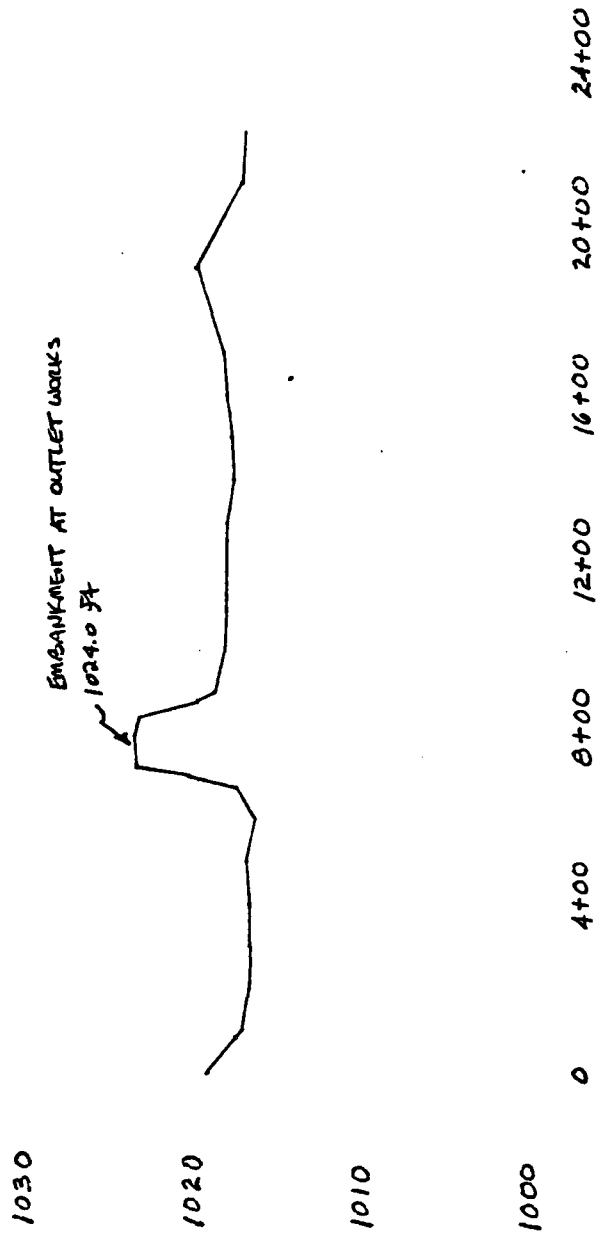
CROSS SECTION AT STA. 11+02



MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject UPPER DAM S.O. No.
TOP OF DAM PROFILE Sheet No. 8 of 23
Drawing No.
Computed by JDD Checked by Date 7/30/80



MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LOWER Dam S.O. No.
HYDROLOGIC DATA Sheet No. 9 of 23
Drawing No.
Computed by LAD Checked by Date 7/30/80

DRAINAGE AREA = 16.5 Sq. Mi.
RUNOFF CURVE NO. = 79 (Antecedent Moisture Condition II)
STORM DURATION = 6 Hours
TIME OF CONCENTRATION = 3.14 Hours

HYDROGRAPH	RAINFALL in.	RUNOFF in.	DISCHARGE cfs
Emergency Spillway	8.2	7.36	8,670.
Freeboard	16.4	13.6	21,550.

NOTE : The above information was taken from the SCS Design Report for Pa. 487. Information concerning the origin of this data is also contained in the design report.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LOWER CAN OUTLET WORKS AND SPILLWAY DISCHARGE RATING S.O. No.
Sheet No. 10 of 23
Drawing No.
Computed by LAD Checked by Date 7/30/80

STAGE Ft. M.S.L.	COMBINED DISCHARGE cfs
1014.0	0
1016.5	19.
1017.0	72.
1017.5	133.
1018.0	202.
1018.5	210.
1019.0	216.
1019.3	220.
1021.06	4,020.
1021.95	7,838.
1022.7	11,683.
1023.34	15,545.
1024.44	23,329.

NOTE: The above information was taken from the SCS Design Report for Pa. 487. Information concerning the origin of this data is also contained in the design report.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject LOWER DAM S.O. No.
STAGE VS STORAGE Sheet No. 11 of 23
INFORMATION Drawing No.
Computed by LAD Checked by Date 7/30/80

STAGE Ft. M.S.L	STORAGE Acre-Ft.
1010.	34.
1011.	190.
1012.	380.
1013.	600.
1014.	850.
1016.	1570.
1018.	2750.
1020.	4270.
1022.	5930.
1025.	8750.

NOTE: The above information was taken from the SCS Design Report for PA 487. Information concerning the origin of this data is also contained in the design report.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject UPPER AND LOWER OFFS S.O. No.
ROUTE 322 CULVERT Sheet No. 12 of 23
Drawing No.
Computed by LAD Checked by Date 7/29/80

Weir Flow
Crest = El. 1018.0

$Q = C L H^{3/2}$

$= 13.2 H^{3/2}$

$C = 3.3$
$L = 4$ Ft.
$H = 1.0, 3.0, 5.0$ Ft.

El. 1019.0 $Q_{1.0} = 13.2$ cfs
El. 1021.0 $Q_{3.0} = 68.59$ cfs
El. 1023.0 $Q_{5.0} = 147.58$ cfs

Pipe Flow
Crest = El. 1018.0

$Q = A \sqrt{\frac{2g H}{\Sigma K_L}}$

$= 33.6 \sqrt{\frac{64.4}{2} \times H}$

$= 190.66 \sqrt{H}$

$\Sigma K_L = 2.0$
$g = 32.2$
$H = 6.0, 10.0, 15.0, \& 20.0$ FT.
$A = 5.6 \times 6.0$
$= 33.6$ Sq. Ft.

El. 1024. $Q_{6.0} = 467.03$ cfs
El. 1028. $Q_{10.0} = 602.93$ cfs
El. 1033. $Q_{15.0} = 738.44$ cfs
El. 1038. $Q_{20.0} = 852.67$ cfs

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1973
  LAST MODIFICATION  26 FEB 79
  MBJ UPDATE         04 JUN 79
**********
    1              A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
    2              A2       HYDROLOGIC AND HYDRAULIC ANALYSES OF UPPER AND LOWER DAMS
    3              A3       UNIT GRAPH BY SNYDERS METHOD
    4              B    300       0       30        0        0        0        0        0       -4        0
    5              B1     5
    6              J      1       1        1
    7              J1  1.00
    8              K      0       1                                                  1
    9              K1       RUNOFF HYDROGRAPH TO RTE 322 FROM AREA 5
   10              M      1       1     7.24
   11              P              23.3     117      127      141      151
   12              T                                                          1.0     0.05
   13              W   6.23     0.40
   14              X   -1.5    -0.05      2.0
   15              K      1       2                                                  1
   16              K1       ROUTING FOR RTE 322
   17              Y                                        1        1
   18              Y1     1                                                  -1018.0      -1
   19              Y41018.0  1019.0  1021.0  1023.0  1024.0  1028.0  1033.0  1038.0
   20              Y5     0    13.2    68.6   147.6   467.0   602.9   739.4   852.7
   21              $A  46.1   372.5   535.7
   22              $E1010.0  1020.0  1030.0
   23              $$1018.0
   24              $D1029.6    3.08     1.5    75.0
   25              K      0       3                                                  1
   26              K1       RUNOFF HYDROGRAPH TO UPPER DAM LOCATION FROM AREA 4
   27              M      1       1     2.09
   28              P              23.3     117      127      141      151
   29              T                                                          1.0     0.05
   30              W   4.24     0.40
   31              X   -1.5    -0.05      2.0
   32              K      0       4                                                  1
   33              K1       RUNOFF HYDROGRAPH TO UPPER DAM LOCATION FROM AREA 3
   34              M      1       1     3.48
   35              P              23.3     117      127      141      151
   36              T                                                          1.0     0.05
   37              W   5.46     0.40
   38              X   -1.5    -0.05      2.0
   39              K      3       5                                                  1
   40              K1       COMBINE HYDROGRAPHS FROM AREAS 3 4 5
   41              K      0       6                                                  1
   42              K1       RUNOFF HYDROGRAPH TO LOWER DAM FROM AREA 2
   43              M      1       1     2.36
   44              P              23.3     117      127      141      151
   45              T                                                          1.0     0.05
   46              W   4.79     0.40
   47              X   -1.5    -0.05      2.0
   48              K      3       7                                                  1
   49              K1       RUNOFF HYDROGRAPH TO LOWER DAM FROM AREA 1
   50              M      1       1     7.43
```

```
P          23.3      117       127       141       151
T                                                          1.0       0.05
W   6.75   0.40
X   -1.5   -0.05     2.0
K          1                                                1
K1         COMBINE HYDROGRAPHS FROM UPPER DAM AND AREAS 1 2
K          1         9                                      1
K1         ROUTING FOR LOWER DAM
Y                                      1         1
Y1         1                                                    -1014.0          -1
Y4 1014.3  1016.5    1017.0    1017.5    1018.0    1018.5    1019.0    1019.3 1021.05 1021.95
Y4 1022.7  1023.35   1024.44
Y5         0         19.0      72.0      133.0     202.0     210.0     216.0     220.0  4020.0   7838.0
Y5 11693.  15565.3   23229.0
$S  34.0   190.0     380.0     600.0     850.0     1570.0    2750.0    4270.0    5930.0   8750.0
$E 1010.3  1011.3    1012.0    1013.0    1014.0    1016.0    1018.0    1020.0    1022.0   1025.0
$$ 1014.3
$$ 1024.3  3.38      1.5       850.0
K          99
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
  MBJ UPDATE         04 JUN 79
**********

RUN  DATE 07/30/80
     TIME    15.40
```

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSES OF UPPER AND LOWER DAMS
UNIT GRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NDR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAT
300	0	30	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

RTIOS= 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO RTE 322 FROM AREA 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	7.24	0.0	7.24	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.30	117.00	127.00	141.00	151.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 6.23 CP=0.40 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 6.25 HOURS, CP= 0.40 VOL= 0.98

6.	23.	47.	76.	109.	145.	182.	218.	248.	273.
292.	305.	307.	299.	287.	275.	264.	253.	241.	231.
222.	212.	203.	195.	187.	179.	171.	164.	157.	150.
144.	133.	132.	127.	121.	116.	111.	107.	102.	98.

94.	90.	86.	82.	79.	76.	72.	69.	65.	64.
61.	58.	56.	54.	51.	49.	47.	45.	43.	41.
40.	38.	36.	35.	33.	32.	31.	29.	28.	27.
26.	25.	24.	23.	22.	21.	20.	19.	18.	17.
17.	16.	15.	15.	14.	14.	13.	12.	12.	11.
11.	10.	10.	10.	9.	9.	8.	8.	8.	7.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	28.15	25.71	2.43	237812.
										(715.)(	653.)(	62.)(	6734.99)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING FOR RTE 322

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1018.	-1

STAGE	1018.00	1019.00	1021.00	1023.00	1024.00	1028.00	1033.00	1038.00
FLOW	0.0	13.20	68.60	147.60	467.00	602.90	738.40	892.70

SURFACE AREA=	46.	373.	536.
CAPACITY=	0.	1832.	6349.
ELEVATION=	1010.	1020.	1030.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
1018.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1029.0	3.1	1.5	75.

PEAK OUTFLOW IS 1810. AT TIME 62.50 HOURS

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO UPPER DAM LOCATION FROM AREA 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.09	0.0	2.09	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.30	117.00	127.00	141.00	151.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA

TP= 4.24 CP=0.40 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 90 END-OF-PERIOD ORDINATES, LAG= 4.23 HOURS, CP= 0.40 VOL= 1.00

4.	17.	34.	55.	78.	99.	115.	126.	129.	124.
116.	109.	103.	96.	91.	85.	80.	75.	70.	66.
62.	58.	55.	52.	48.	45.	43.	40.	38.	35.
33.	31.	29.	28.	26.	24.	23.	21.	20.	19.
18.	17.	16.	15.	14.	13.	12.	11.	11.	10.
9.	9.	8.	8.	7.	7.	7.	6.	6.	5.
5.	5.	4.	4.	4.	4.	3.	3.	3.	3.
3.	3.	2.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM	28.15	25.71	2.43	69284.
	(715.1)	(653.1)	(62.1)	(1961.9)

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO UPPER DAM LOCATION FROM AREA 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.48	0.0	3.48	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.30	117.00	127.00	141.00	151.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA

TP= 5.46 CP=0.40 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 5.46 HOURS, CP= 0.40 VOL= 0.99

4.	15.	32.	51.	73.	96.	119.	138.	153.	164.
168.	165.	157.	150.	142.	136.	129.	123.	117.	112.

106.	101.	97.	92.	85.	84.	80.	76.	72.	69.
66.	62.	59.	57.	54.	51.	49.	47.	44.	42.
40.	38.	37.	35.	33.	32.	30.	29.	27.	26.
25.	24.	23.	21.	20.	19.	19.	18.	17.	16.
15.	15.	14.	13.	13.	12.	11.	11.	10.	10.
9.	9.	9.	8.	8.	7.	7.	7.	6.	6.
6.	5.	5.	5.	5.	5.	4.	4.	4.	4.
4.	3.	3.	3.	3.	3.	3.	3.	2.	2.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SU4	23.15	25.71	2.43	1149.3.
										(715.)(	663.)(	62.)(	3254.26)

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS FROM AREAS 3 4 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	3	0	0	0	0	1	0	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO LOWER DAM FROM AREA 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAT
1	1	2.36	0.0	2.36	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.30	117.00	127.00	141.00	151.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA

TP= 4.79 CP=0.40 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 4.77 HOURS, CP= 0.40 VOL= 0.99

4.	14.	29.	47.	67.	87.	104.	117.	126.	129.
125.	118.	112.	106.	100.	95.	90.	85.	80.	76.
72.	68.	64.	61.	58.	55.	52.	49.	46.	44.
41.	39.	37.	35.	33.	31.	30.	28.	27.	25.
24.	22.	21.	20.	19.	18.	17.	16.	15.	14.
14.	13.	12.	12.	11.	10.	10.	9.	9.	8.
8.	7.	7.	7.	6.	6.	6.	6.	5.	5.
4.	4.	4.	4.	4.	3.	3.	3.	3.	3.

3.	2.	2.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

END-OF-PERIOD FLOW

O MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SU4	28.15	25.71	2.43	78177.
										(715.1(	653.1(	62.1(	2213.73)

********** *********** ********** ********* **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO LOWER DAM FROM AREA 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	7.43	0.0	7.43	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.30	117.00	127.00	141.00	151.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA

TP= 6.75 CP=0.40 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 6.77 HOURS, CP= 0.40 VOL= 0.98

5.	19.	40.	65.	92.	123.	155.	188.	218.	243.
264.	279.	289.	292.	285.	274.	263.	253.	243.	234.
225.	216.	207.	199.	192.	184.	177.	170.	163.	157.
151.	145.	139.	134.	129.	124.	119.	114.	110.	105.
101.	97.	94.	90.	86.	83.	80.	77.	74.	71.
68.	65.	63.	60.	58.	56.	54.	52.	50.	48.
46.	44.	42.	41.	39.	38.	36.	35.	33.	32.
31.	30.	28.	27.	26.	25.	24.	23.	22.	21.
21.	20.	19.	18.	18.	17.	16.	16.	15.	14.
14.	13.	13.	12.	12.	11.	11.	11.	10.	10.

END-OF-PERIOD FLOW

O MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SU4	28.15	25.71	2.43	242600.
										(715.1(	653.1(	62.1(	6875.34)

********** *********** *********** ************ ***********

COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS FROM UPPER DAM AND AREAS 1 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	3	0	0	0	0	1	0	0

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING FOR LOWER DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
9	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.0	0.0	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1014.	-1

STAGE	1014.00	1016.50	1017.00	1017.50	1018.00	1018.50	1019.00	1019.30	1021.00	1021.75
	1022.70	1023.34	1024.44							
FLOW	0.0	19.00	72.00	133.00	202.00	210.00	216.00	220.00	4020.00	7944.00
	11683.00	15545.00	23329.00							
CAPACITY=	34.	150.	330.	600.	850.	1570.	2750.	4270.	5977.	8750.
ELEVATION=	1010.	1011.	1012.	1013.	1014.	1016.	1018.	1020.	1022.	1025.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1014.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1024.0	3.1	1.5	850.

PEAK OUTFLOW IS 12692. AT TIME 48.50 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00
				RATIOS APPLIED TO FLOWS
HYDROGRAPH AT	1	7.24 (18.75)	1	6561. (185.79)
ROUTED TO	2	7.24 (18.75)	1	1810. (51.26)
HYDROGRAPH AT	3	2.09 (5.41)	1	2552. (72.27)
HYDROGRAPH AT	4	3.48 (9.01)	1	3490. (98.82)
3 COMBINED	5	12.81 (33.18)	1	6407. (181.44)
HYDROGRAPH AT	6	2.36 (6.11)	1	2624. (74.31)
HYDROGRAPH AT	7	7.43 (19.24)	1	6309. (178.66)
3 COMBINED	8	22.60 (58.53)	1	15011. (425.06)
ROUTED TO	9	22.60 (58.53)	1	12692. (359.41)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1018.00	1018.00	1029.60
STORAGE	1180.	1180.	6136.
OUTFLOW	0.	0.	649.

— FLOW THROUGH CULVERT UNDER RT. 322 AND THROUGH RAILROAD UNDERPASS.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1032.41	2.81	7691.	1810.	41.50	42.50	0.0

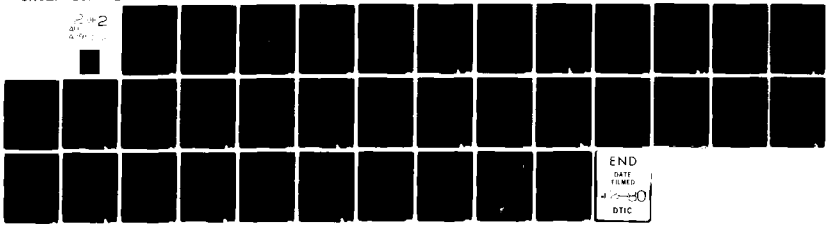
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM - LOWER DAM
ELEVATION	1014.00	1014.00	1024.00
STORAGE	850.	850.	7810.
OUTFLOW	0.	0.	20216.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1022.87	0.0	6745.	12692.	0.0	48.50	0.0

AD-A091 280 BAKER (MICHAEL) JR INC BEAVER PA F/G 13/13
NATIONAL DAM SAFETY PROGRAM. UPPER AND LOWER DAMS (NDI NUMBER P--ETC(U)
AUG 80 DACW31-80-C-0025
UNCLASSIFIED NL



APPENDIX E

PLATES

CONTENTS

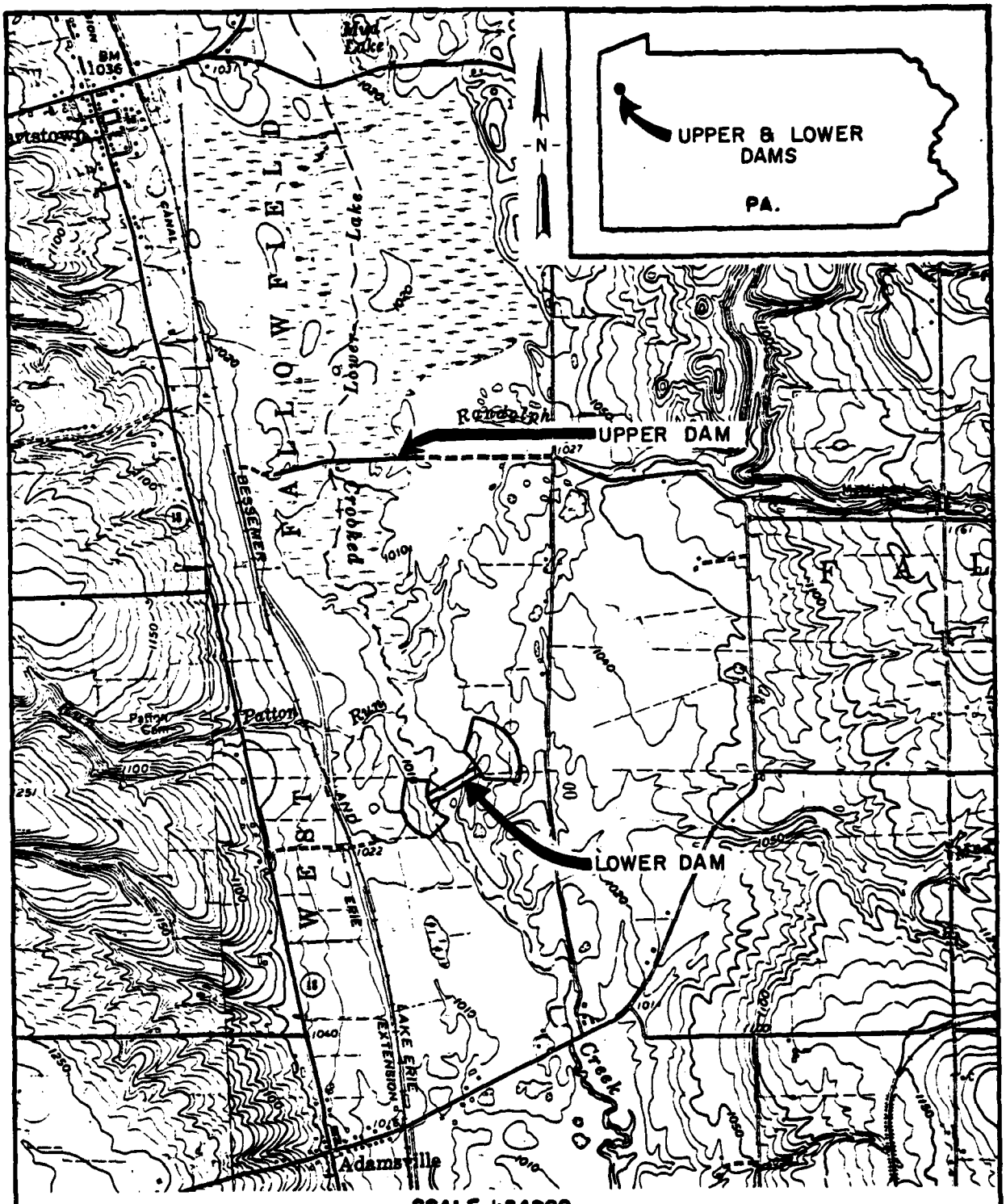


PLATE 1 LOCATION PLAN

UPPER & LOWER DAMS

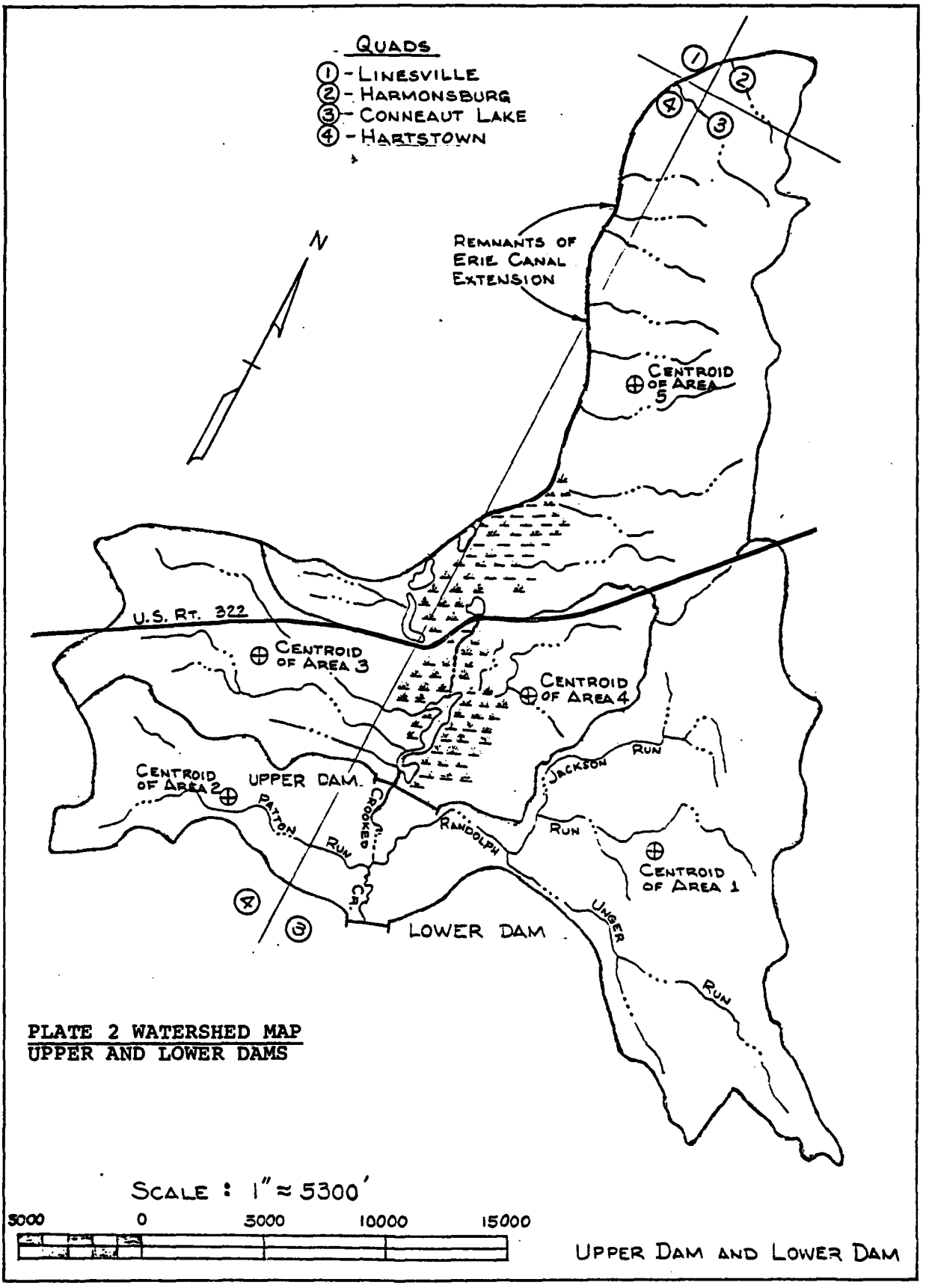
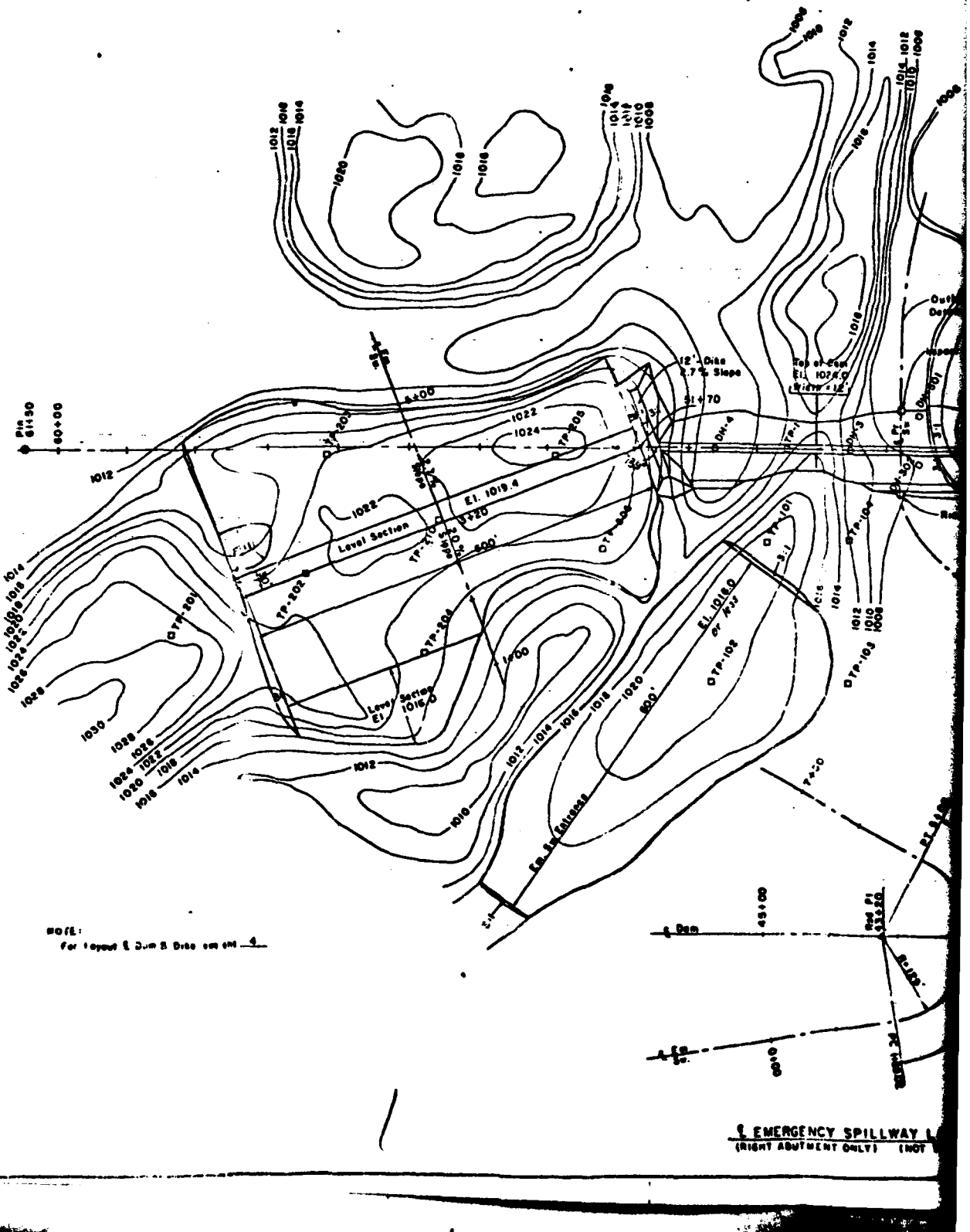
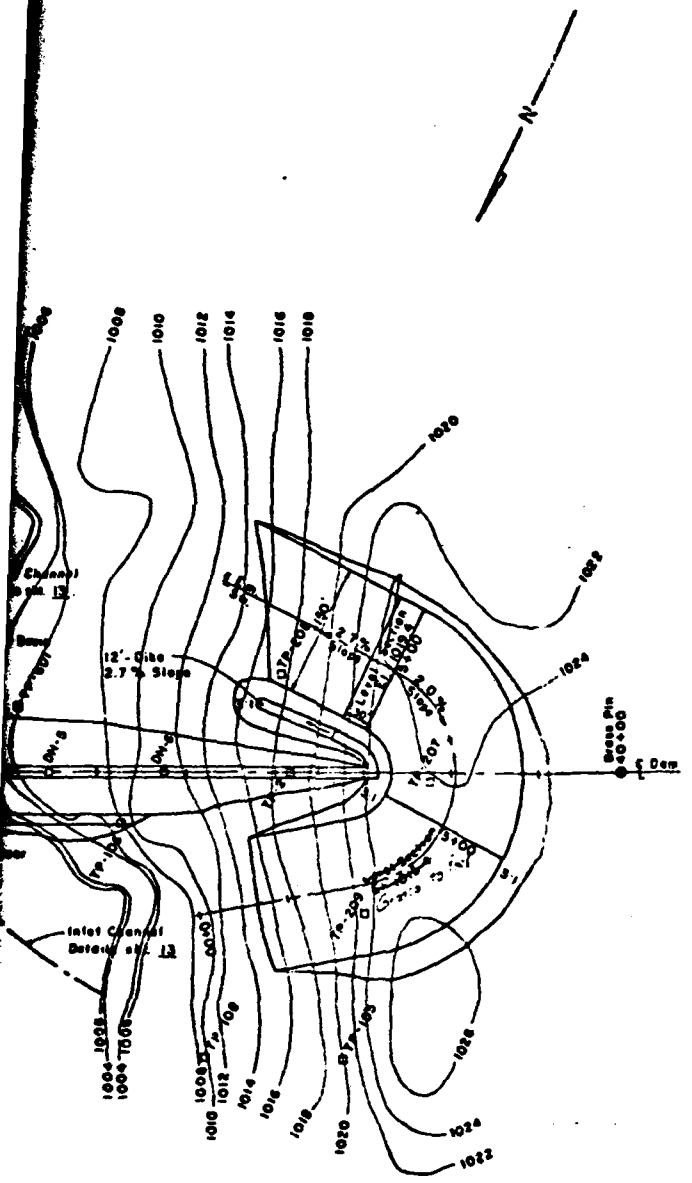
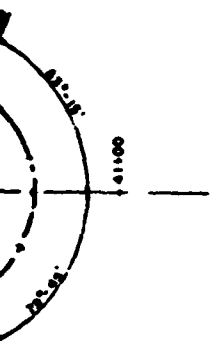


PLATE 2 WATERSHED MAP
UPPER AND LOWER DAMS

UPPER DAM AND LOWER DAM


Level Section
El. 1019.4
Level Section
El. 1018.0
12' Dike
2.7% Slope
Top of Dam
El. 1028.0
Width = 12'
Dam
EMERGENCY SPILLWAY
(RIGHT ABUTMENT ONLY)
NOTE:





CURVE DATA	
Δ	= 143°-00'
R	= 125.00'
T	= 373.99'
C	= 237.08'
L_c	= 311.98'
M	= 85.34'
E	= 268.95
PC	= 1+86.02
PT	= 3+00.00

PLATE 3

AS BUILT PLANS

0 50 100 200 FEET

SCALE

LITTLE SHENANGO RIVER WATERSHED

MULTIPLE PURPOSE DAM PA-487-2

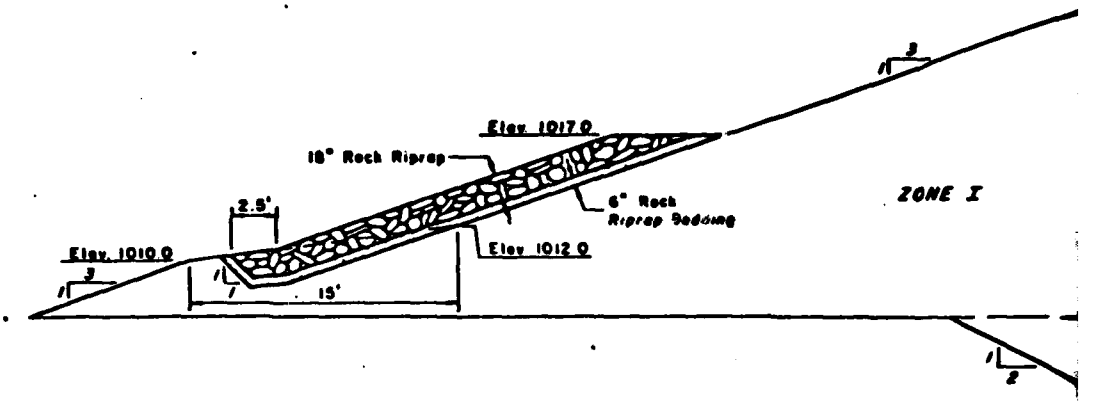
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA

PLAN OF STRUCTURAL WORKS

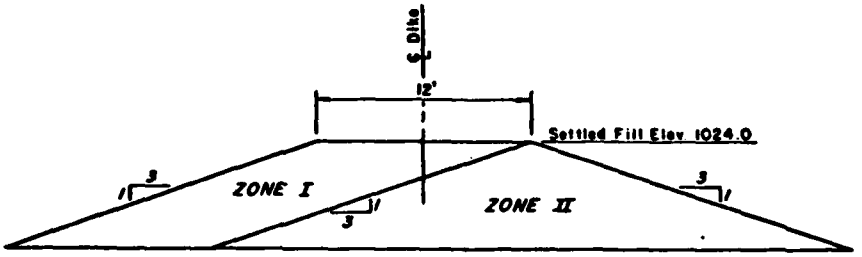
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date
[illegible]	4-72
R A STALTER	12-71
[illegible]	[illegible]

PA-487-4-P

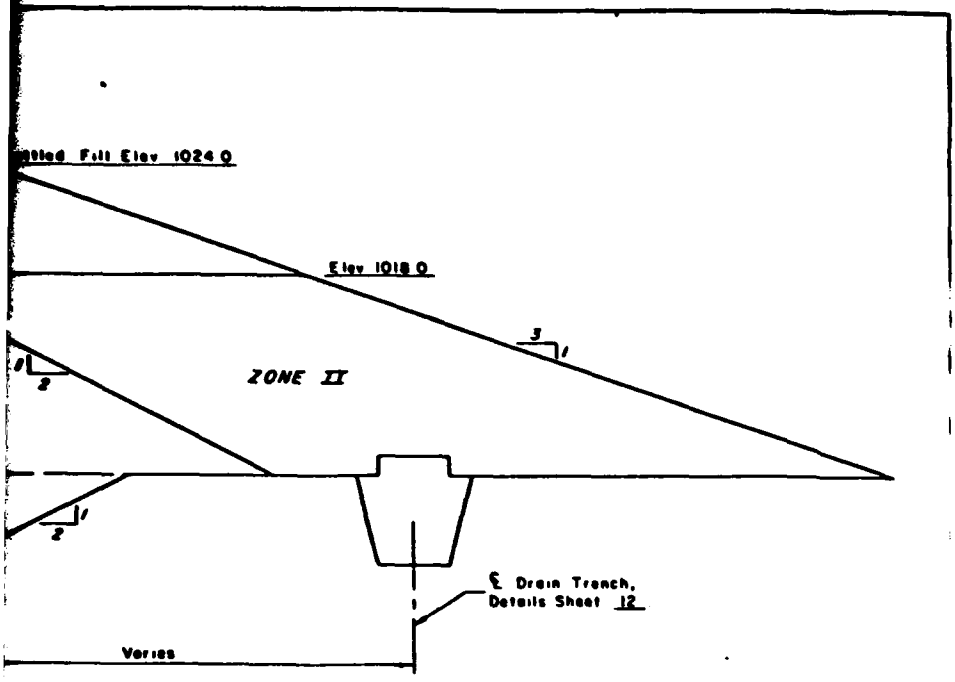


TYPICA



TYPICAL SECTION OF DIKE

0 1 5 10 FEET
SCALE



SELECTIVE PLACEMENT	MATERIAL	MAX ROCK SIZE	MAX. [11] LIFT	REQ'D WATER [12] CONTENT	COMPACTION [13] CLASS	COMPACTION [13] DEFINITION
ZONE I	Material as represented by TP-206, depth 1.0' to 5.0', classified as ML.	6"	9"	Optimum -2% to +2%	A	95% Max density by ASTM D-698, Method "A"
ZONE II	Material as represented by TP-208, depth 1.1' to 8.0', classified as SM.	6"	12"	Optimum to -3% +2%	A	95% Max density by ASTM D-698, Method "A"
ZONE III	Material as represented by TP-204, depth 1.0' to 10.5', classified as CL.	6"	9"	Optimum -2% to +2%	A	95% Max density by ASTM D-698, Method "A"

[11] Maximum permissible lift thickness before compaction

[12] Water content of fill matrix at time of compaction. Variation from water content shown may be approved by the Engineer.

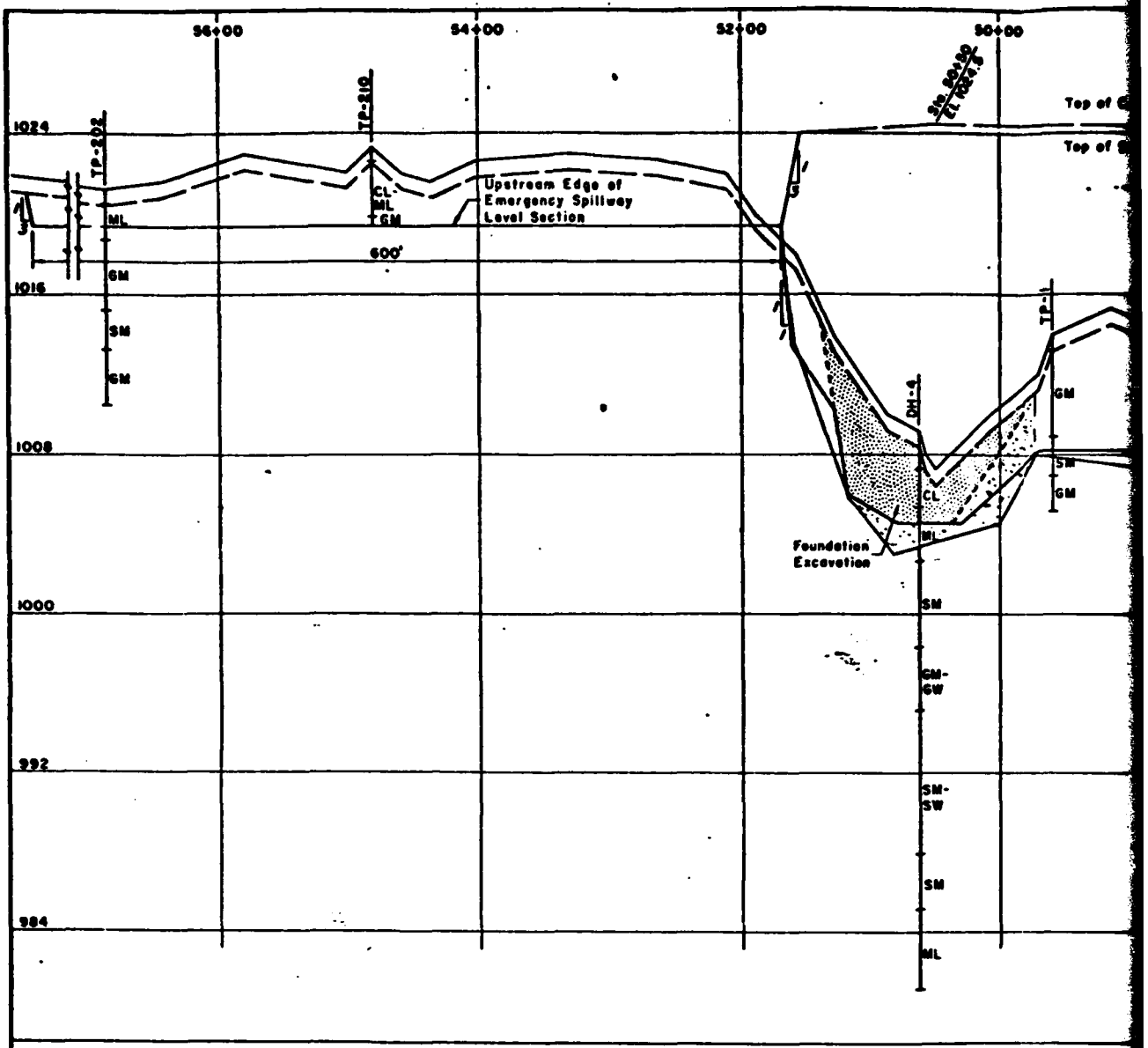
[13] For typical compaction curves, see sheet 43.

PLATE 4
AS BUILT PLANS

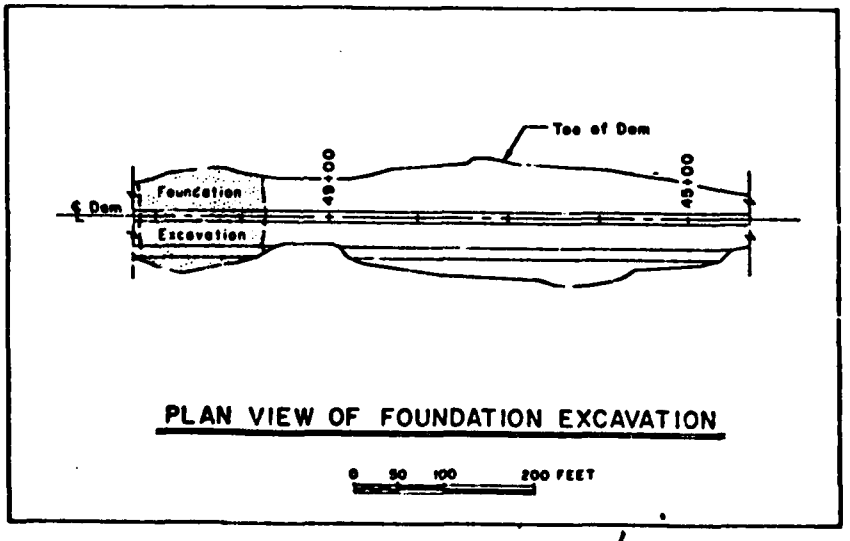
LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM PA-487A
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA
FILL PLACEMENT

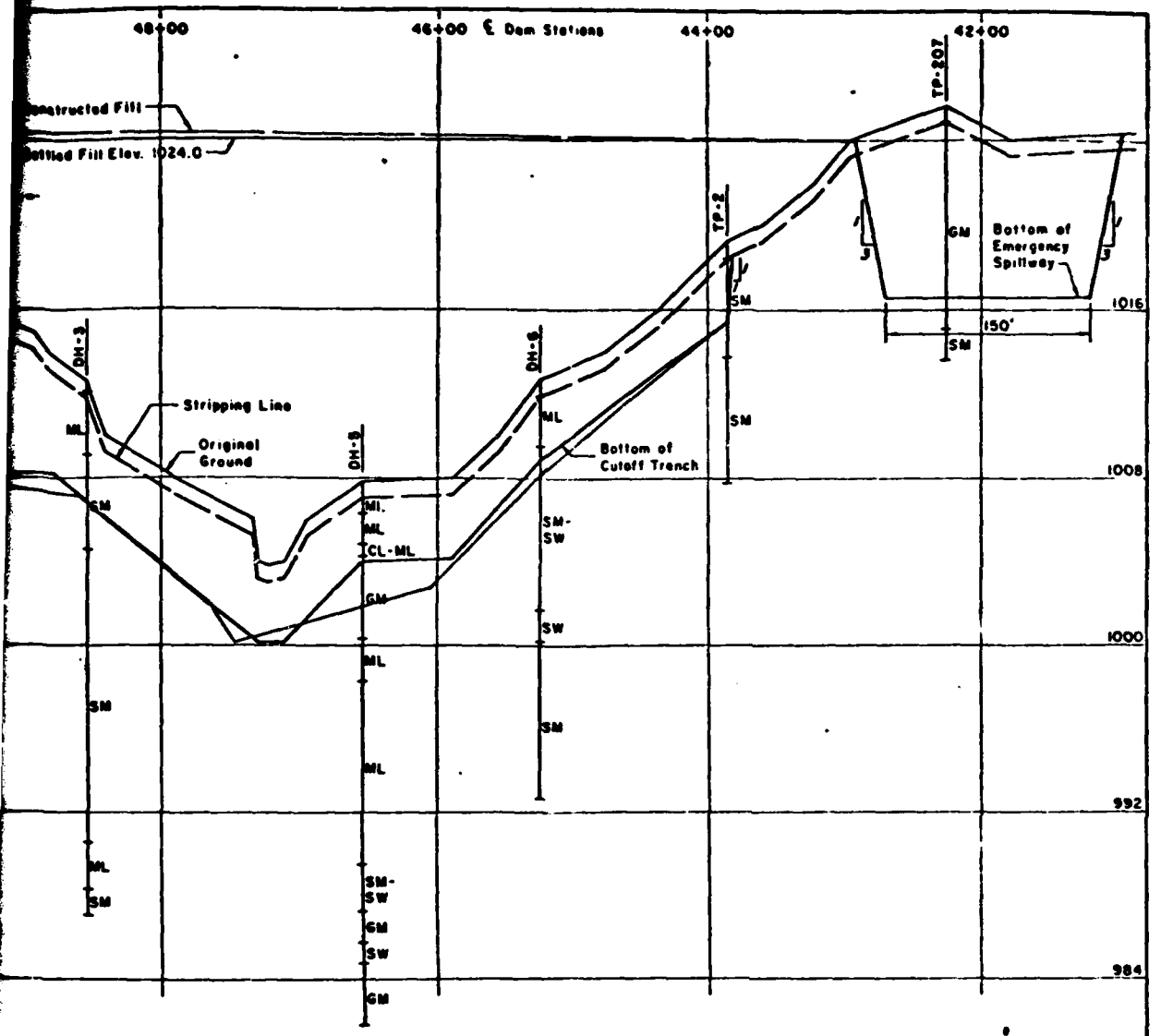
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed John Gathman 4-74
Drawn R A STALTER 1-75
Traced
Recommended Leach 4-75
Approved by
Title
Title
Title
Drawing No. 7 of 43
PA-487A-



PROFILE ALONG C



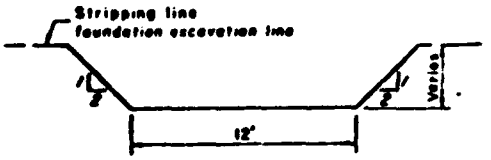


CENTERLINE OF DAM

CONSTRUCTION NOTES

1. For logs of drill holes and test pits see sheets 40 thru 42
2. ℄ Dam = ℄ Cutoff trench

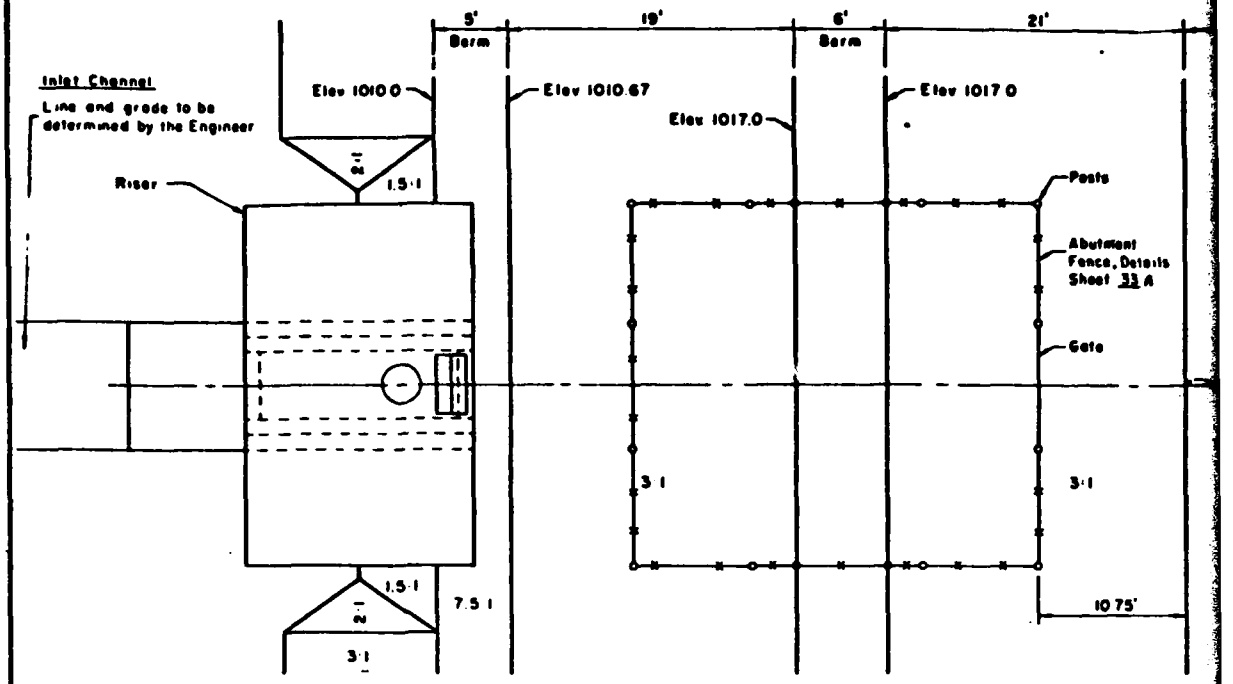
PLATE 5
AS BUILT PLANS

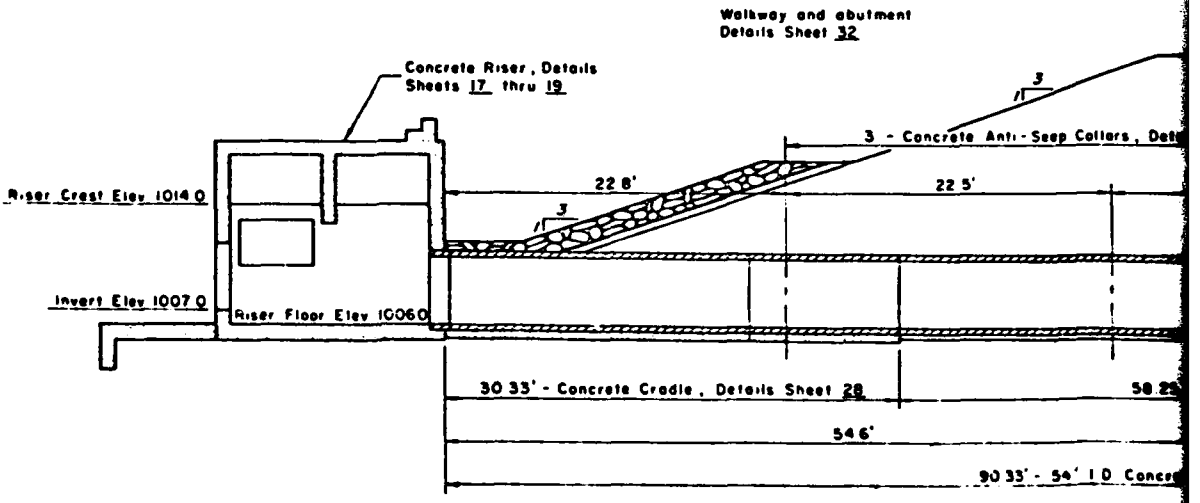


TYPICAL SECTION OF CUTOFF TRENCH

LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM PA-487A
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA
PROFILE ALONG ℄ DAM
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
	4-72	
R A STALTER	11-71	
		PA-487A-P





PROFILE ALONG CENTERLINE

SCALE

CONSTRUCTION NOTES

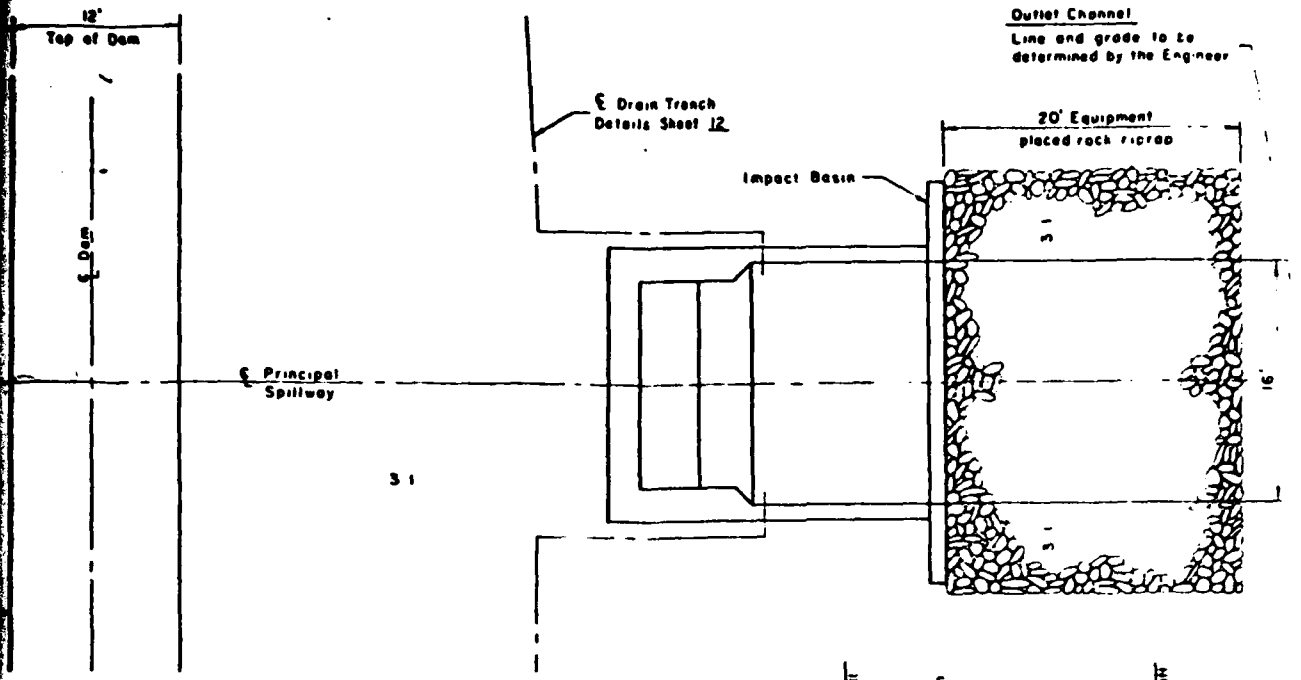
1. Outlet end of 54" pipe (spigot end) to be finished so that no metal is exposed
2. Pipe layout data will be furnished by the Engineer
3. Layout shown is for 20' conduit sections If other sections are used, quantities and some dimensions will change

AS BUILT
54" I.D. PIPE JOINT DATA

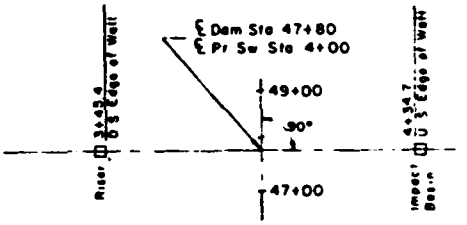
JOINT	DIST FROM RISER WALL	INVERT EL
J-1	0.33	1006.00
J-2	20.33	1006.00
J-3	30.33	1005.98
J-4	50.33	1005.88
J-5	70.33	1005.72
OUT	90.33	1005.50

AS BUILT COLLAR DA
FOR 54" I.D. PIPE

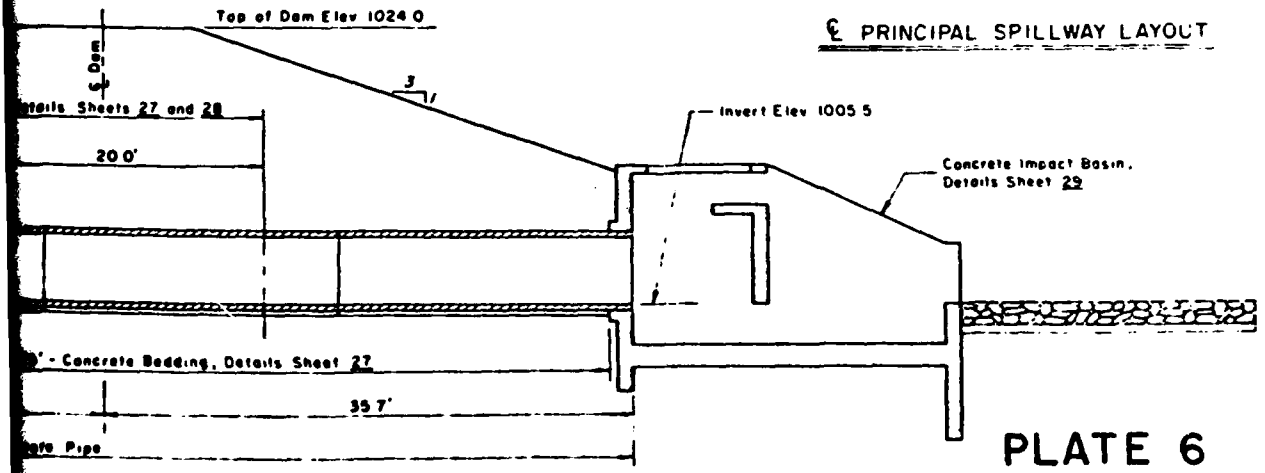
COLLAR	DIST FROM RISER WALL	INVE
I	22.8	10
II	35.3	10
III	65.3	10



PLAN



℄ PRINCIPAL SPILLWAY LAYOUT



PRINCIPAL SPILLWAY

2 FEET

54" I D Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Spec 541 (AWWA C-300 or C-301)

90' - Straight sections
1 - Spigot ring wall fitting (for 12" wall)

90 33' - TOTAL

Pressure head = 20
Load = 15,000 lbs per lin ft , Based on O D of 5 32'
Min 3 edge bearing strength for
0 01" Crack non-prestressed pipe = 6,850 lbs per lin ft
0 001" Crack prestressed pipe = 5,150 lbs per lin ft

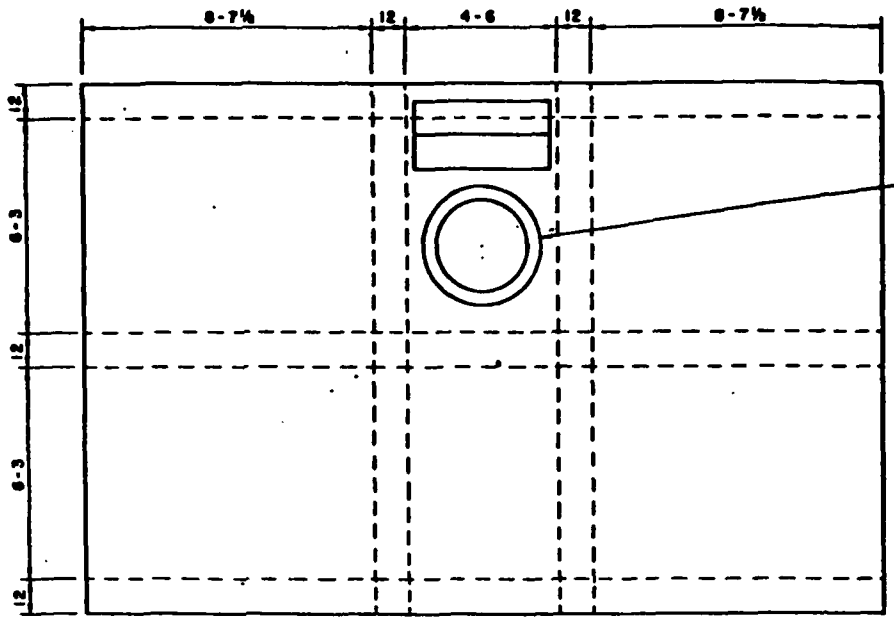
PLATE 6

AS BUILT PLANS

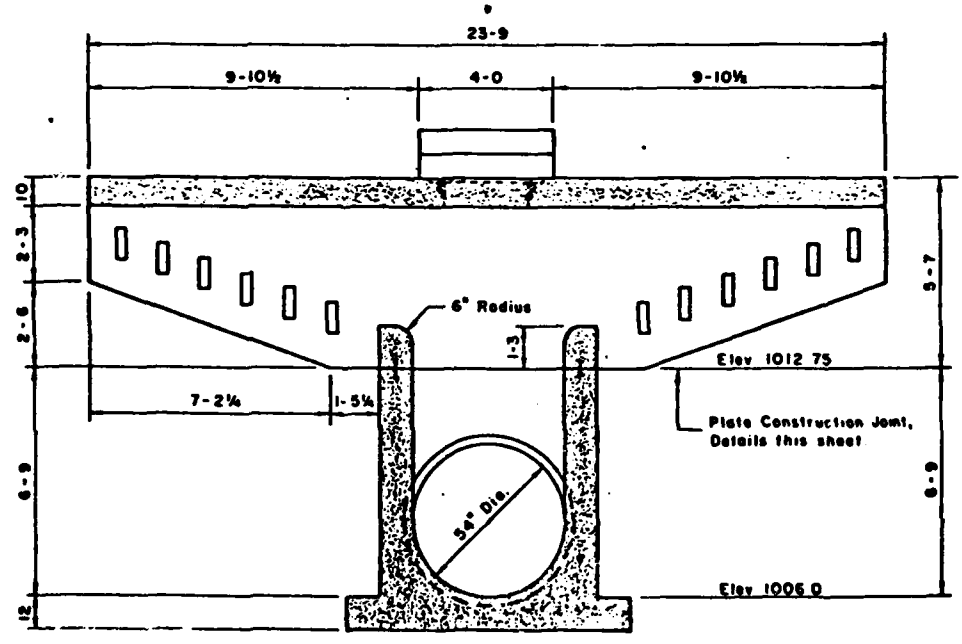
LITTLE SHENANGO RIVER WATERSHED

PRINCIPAL SPILLWAY

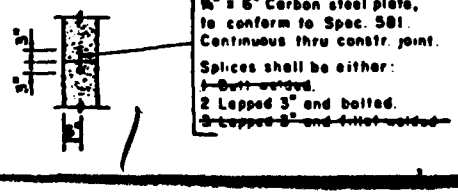
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

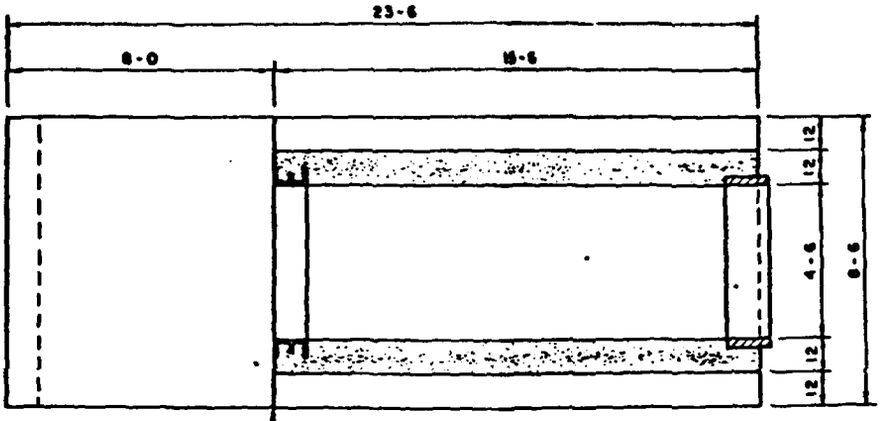


PLAN-TOP



SECTION A-A

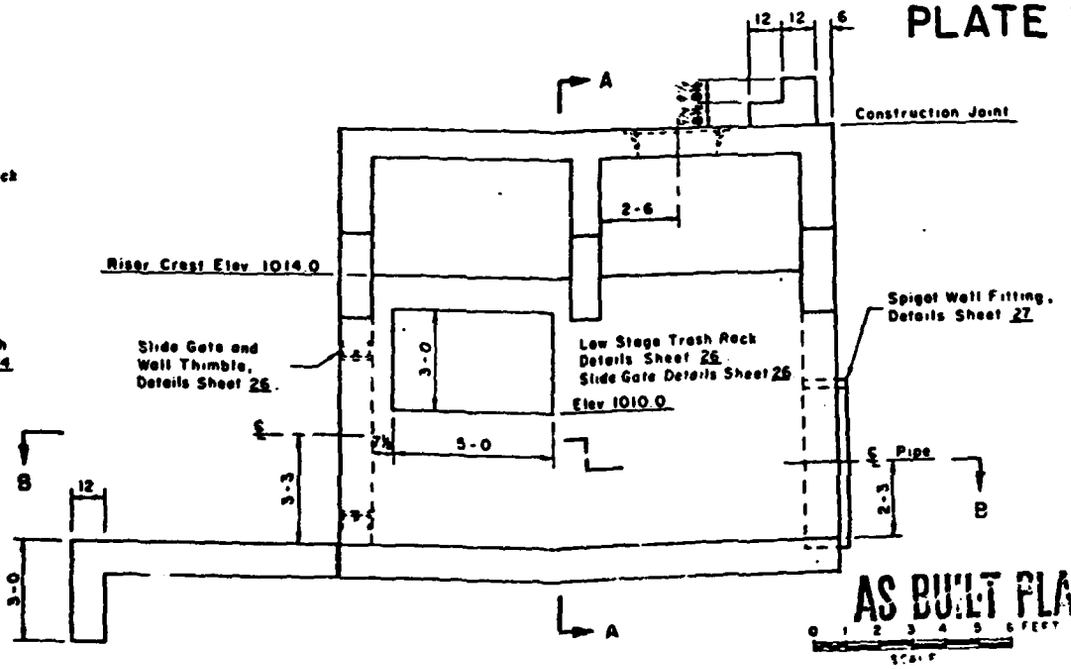




8-6 x 1-0 x ¾ Preformed Joint Filler, Bituminous (Spec 535)

SECTION B-B

PLATE 7



AS BUILT PLANS

SIDE ELEVATION

NOTES

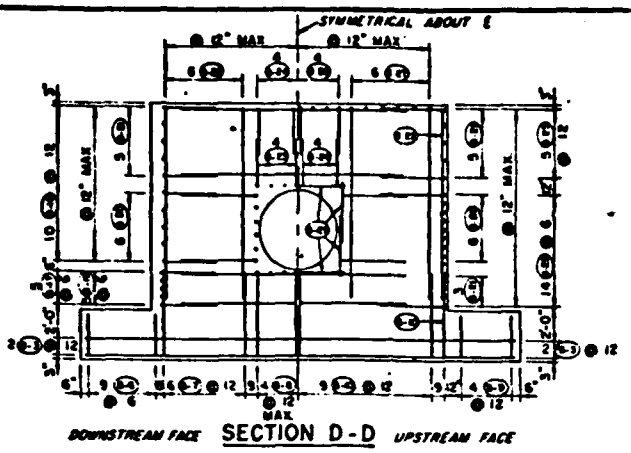
1. Portland Cement type I-A or I with an air-entraining admixture shall be used
2. Thickness of concrete over reinforcing steel shall be 2" in formed surfaces and 3" in unformed surfaces unless noted otherwise
3. All exposed edges of concrete to have a 1" chamfer [illegible] noted

LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM PA-487A
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA
RISER STRUCTURAL DETAILS

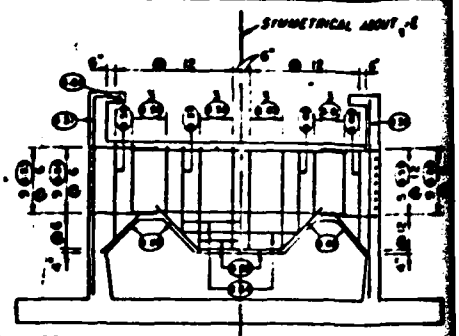
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

[illegible]		9-72
R A STALTER		3-72

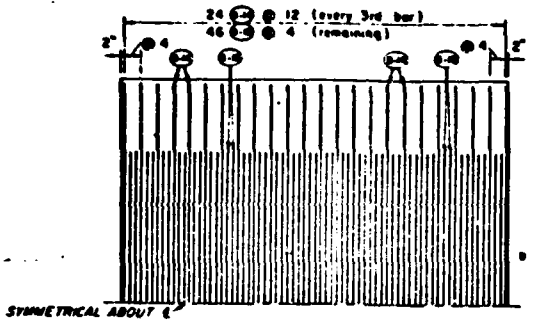
2



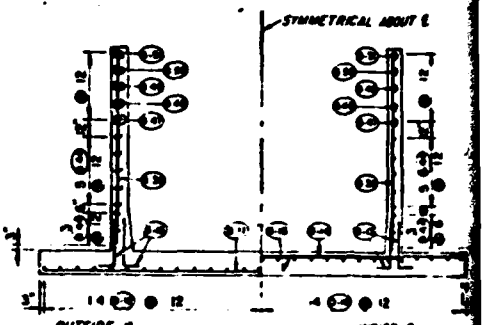
DOWNSTREAM FACE **SECTION D-D** UPSTREAM FACE



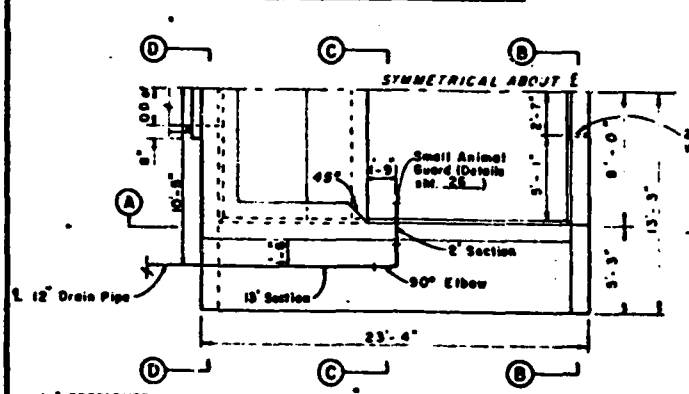
DOWNSTREAM FACE **SECTION THRU BAFFLE** UPSTREAM FACE



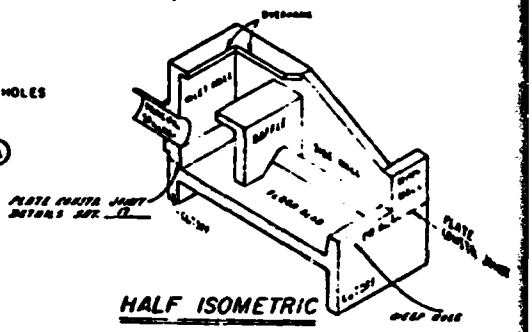
PLAN OF FLOOR SLAB



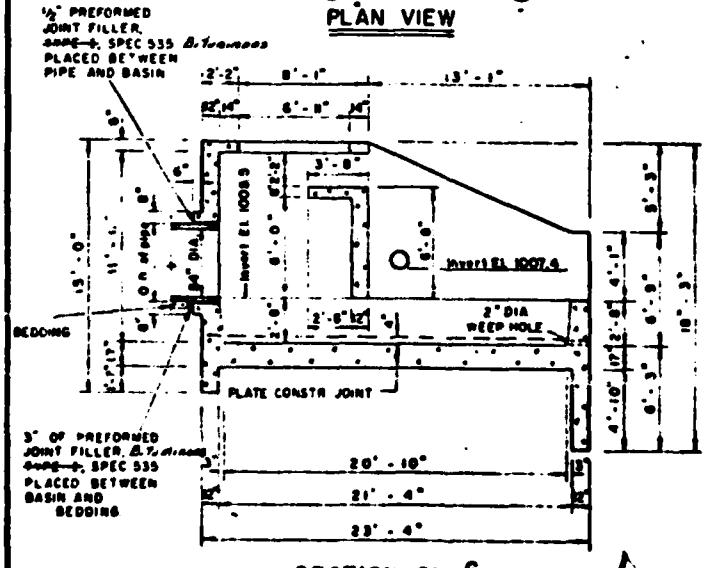
OUTSIDE & BOTTOM FACES **SECTION C-C** INSIDE & TOP FACES



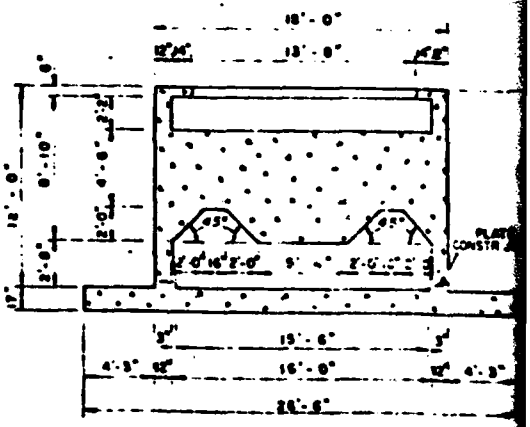
PLAN VIEW



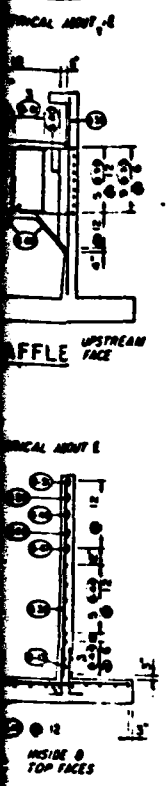
HALF ISOMETRIC

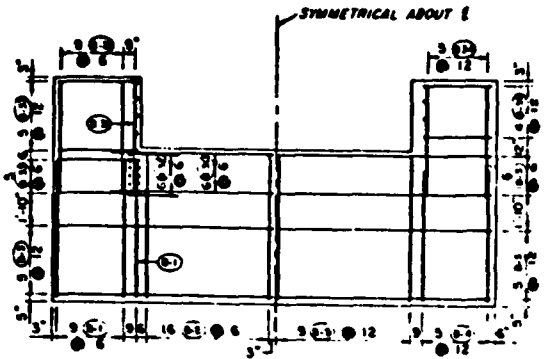


SECTION ON ℄

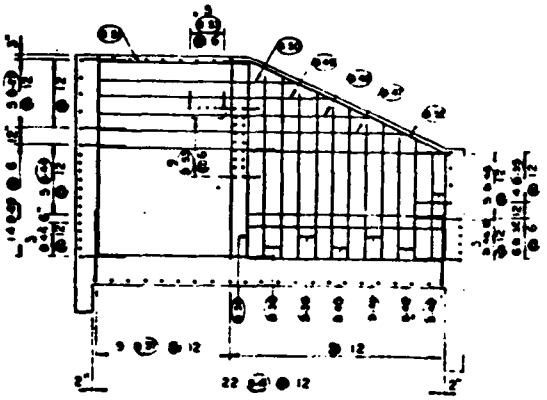


SECTION THRU BAFFLE

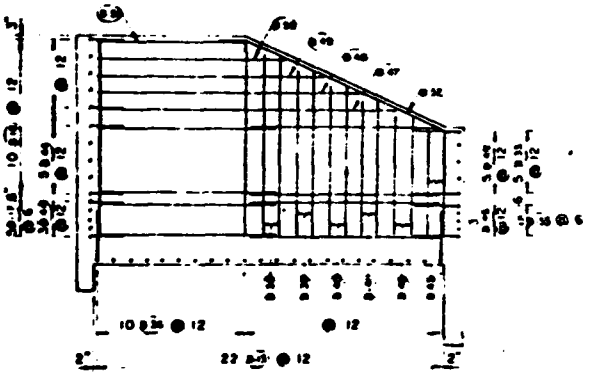




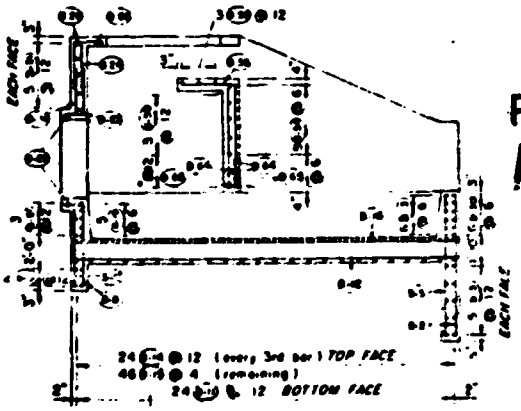
SECTION B-B



SECTION A-A OUTSIDE FACE



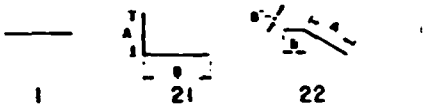
SECTION A-A INSIDE FACE



SECTION ON ℄

STEEL SCHEDULE

MARK	LOCATION	QUANTITY	SIZE	LENGTH	TYPE	A	B	TOTAL FT
B-1	CUTOFF	20	8	8-0	1			160 00
2		32	8	8-6	1			272 00
3		20	5	26-0	1			520 00
4		10	5	8-0	1			80 00
5		17	5	8-9	1			144 80
6		18	8	2-6	1			45 00
7		12	5	5-0	1			60 00
8		7	5	6-0	2	5-0	1-0	42 00
9		8	5	2-6	1			20 00
B-10		18	5	5-0	1			98 00
11	FLOOR SLAB	24	5	26-0	1			624 00
12		27	5	23-0	1			621 00
13		88	5	4-4	2	3-4	1-0	381 33
14		24	8	26-0	1			624 00
B-15		46	8	18-0	1			828 00
16		27	8	23-0	1			621 00
17	INLET WALL	10	5	5-4	2	3-3	2-1	53 33
18		20	5	5-4	2	3-3	2-1	106 67
19		5	7	14-6	1			72 50
B-20		12	5	5-3	2	4-3	1-0	63 00
21		8	5	13-3	1			106 00
22		14	5	11-6	1			161 00
23		7	5	3-9	2	2-9	1-0	24 25
24		14	5	2-9	1			38 50
B-25		58	8	6-4	2	5-9	2-7	240 67
26		12	8	4-3	1			51 00
27		12	5	13-2	2	11-6	1-8	58 00
28		7	5	4-5	2	2-9	1-8	30 92
29		8	5	4-0	1			32 00
B-30	WING WALLS	6	5	14-9	1			88 50
31		20	5	6-3	1			125 00
32		12	6	5-7	2	5-0	2-7	67 00
33		20	6	7-4	2	4-9	2-7	146 67
34		10	6	6-3	1			62 50
B-35		8	5	7-4	2	4-3	3-1	58 67
36	SIDE WALLS	22	5	11-6	1			253 00
37		18	5	13-2	2	11-6	1-8	237 00
38		8	5	10-6	1			84 00
39		8	5	9-9	1			78 00
B-40		8	5	8-9	1			70 00
41		8	5	8-0	1			64 00
42		8	5	7-0	1			56 00
43		8	5	6-9	1			54 00
44		32	5	10-9	1			344 00
B-45		16	5	11-9	1			188 00
46		16	5	11-9	1			188 00
47		4	5	18-6	1			74 00
48		4	5	16-3	1			65 00
49		4	5	14-0	1			56 00
B-50		4	5	11-9	1			47 00
51		4	5	9-0	1			36 00
52		4	5	14-10	22	13-3	1-7	59 33
53	BAFFLE	46	6	4-9	2	3-9	1-0	218 50
54		9	6	16-0	1			144 00
B-55		2	5	8-6	2	5-4	3-2	17 00
56		6	5	7-1	2	5-1	3-2	42 50
57		2	5	8-2	2	5-0	3-2	16 33
58		6	5	9-3	2	6-1	3-2	55 50
59		2	5	15-3	1			76 25
B-60		2	5	5-3	1			10 50
61		6	5	4-0	1			24 00
62		5	5	5-1	1			25 50
63		6	5	6-0	1			36 00
64	BAFFLE B OVERHG	5	5	7-0	1			35 00
P-65	BAFFLE	8	5	3-6	1			28 00
66	OVERHANG	1	5	14-3	1			4 25



BAR TYPES

QUANTITIES THIS SHEET ONLY

REINFORCING STEEL			(GRADE 60)
NO 5 BARS	1333.17	LIN FT	5554.4 LBS
NO 6 BARS	639.00	LIN FT	959.8 LBS
NO 7 BARS	313.83	LIN FT	641.5 LBS
NO 8 BARS	2796.67	LIN FT	7467 LBS
		TOTAL	15162.7 LBS
CONCRETE CLASS 4000	73.3		CU YDS

PLATE 8
AS BUILT PLANS

SCALE

LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM PA-487A
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA
IMPACT BASIN DETAILS
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

W NIKOLICH
H T BROWNING
Jan 86

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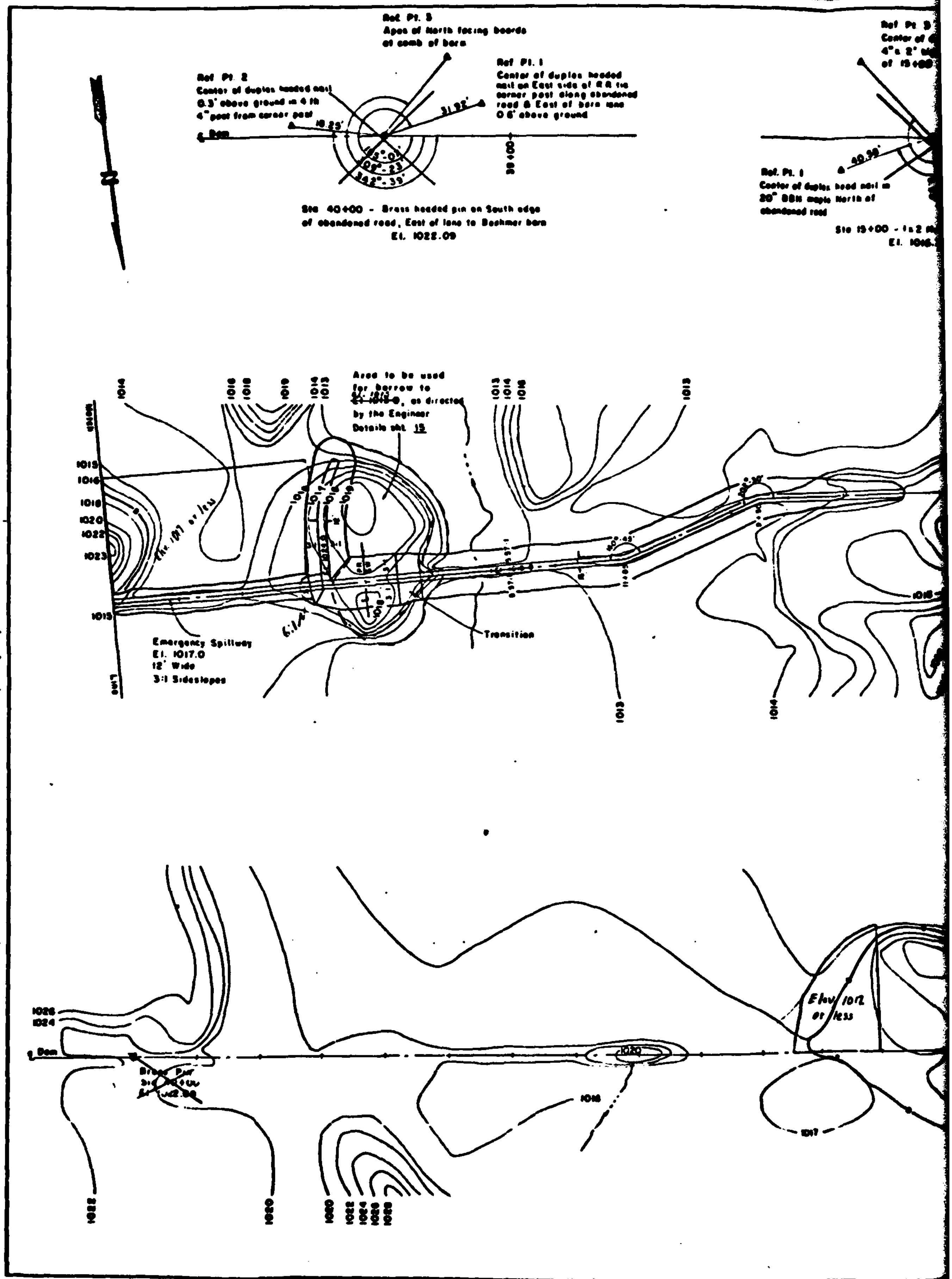
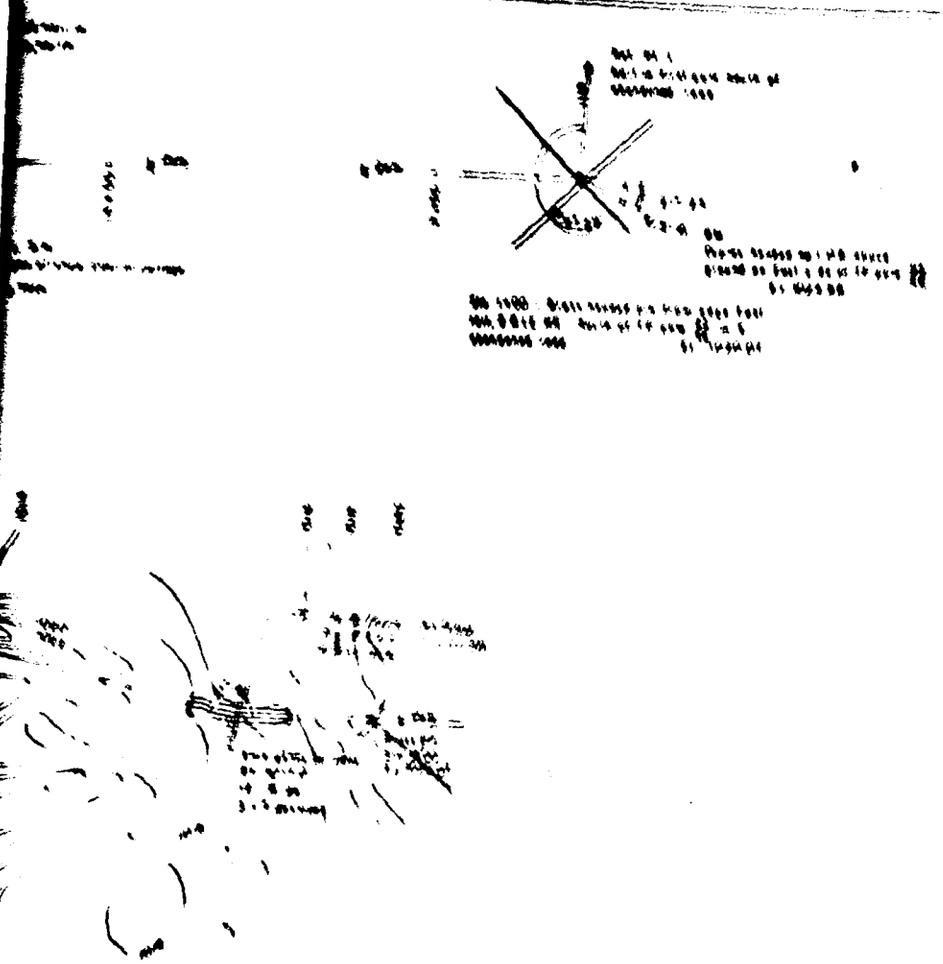
PA-487A-

Construction Details
See Sheet 17



Ref. Pt. 3
Apex of North facing boards at comb of barn
Ref. Pt. 2
Center of duplex headed nail 0.3' above ground in 4 ft 4" post from corner post
Ref. Pt. 1
Center of duplex headed nail on East side of R.R. tie corner post along abandoned road & East of barn lane 0.6' above ground
Sta. 40+00 - Brass headed pin on South edge of abandoned road, East of lane to Boehmer barn
El. 1022.09
Ref. Pt. 1
Center of duplex head nail in 20" BBH maple North of abandoned road
Area to be used for borrow to El. 1018, as directed by the Engineer
Details sht. 15
Emergency Spillway
El. 1017.0
12' Wide
3:1 Sideslopes
Transition
Elev. 1012 or less



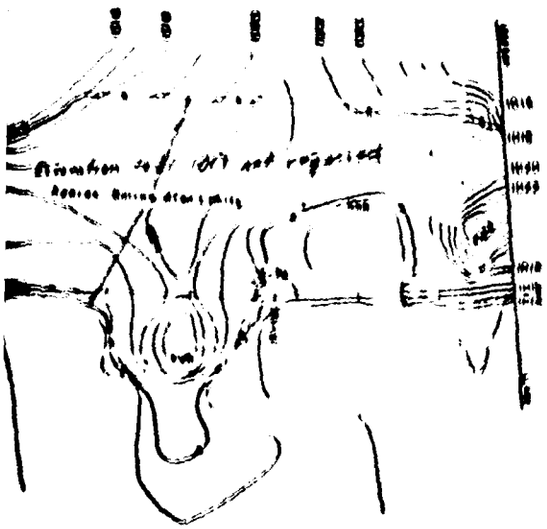


PLATE 9

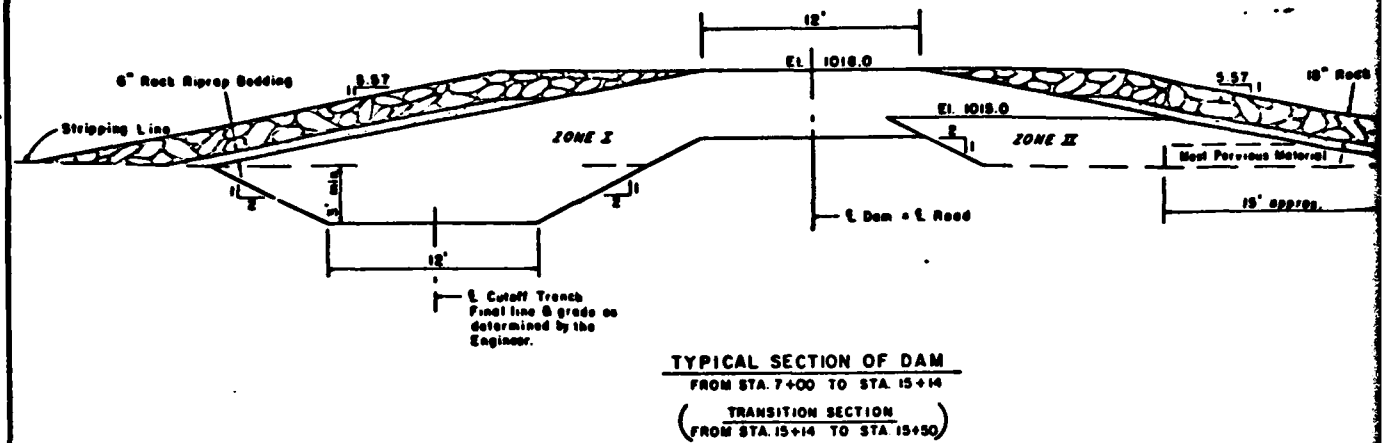
AS BUILT PLANS

LITTLE SHENANGO RIVER WATERSHED

PLAN OF STRUCTURAL WORKS

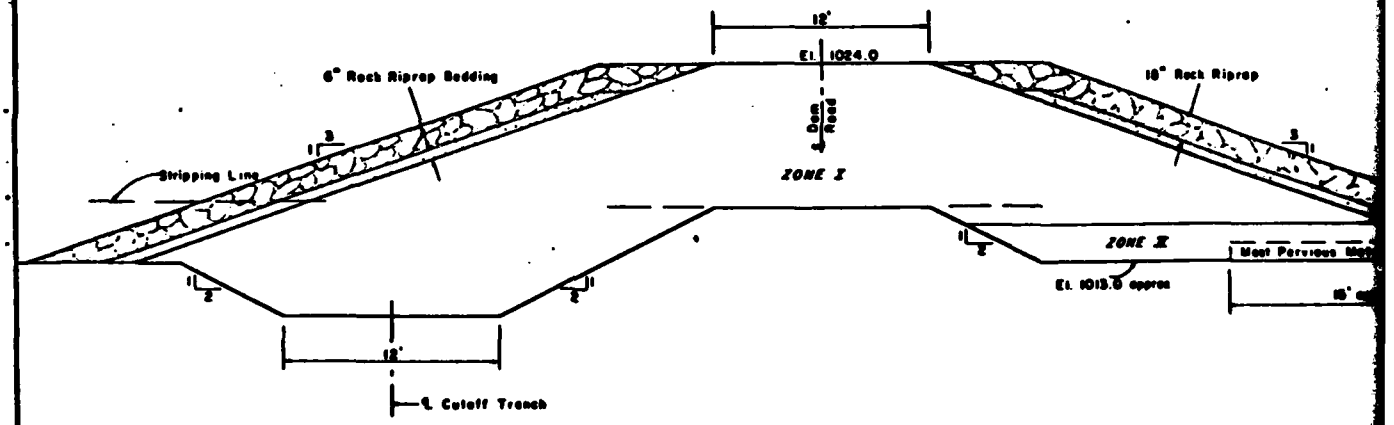
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PA 481B-P

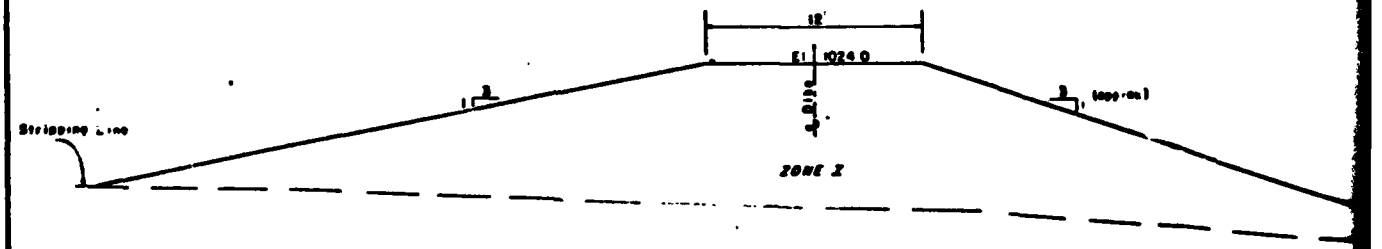


TYPICAL SECTION OF DAM
FROM STA. 7+00 TO STA. 15+14

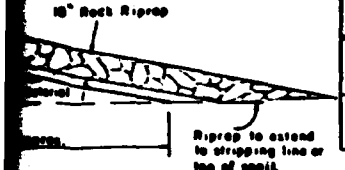
(TRANSITION SECTION
FROM STA. 15+14 TO STA. 15+50)



TYPICAL SECTION OF DAM
FROM STA 15+50 TO STA. 16+85



TYPICAL SECTION OF DIKE



SELECTIVE PLACEMENT	MATERIAL	MAX. ROCK SIZE	MAX. LIFT [1]	REQ'D WATER CONTENT [2]	COMPACTION [3]	
					CLASS	DEFINITION
I	Material as represented by TP-5, depth 0.5' to 7.0' Classified as CL	6"	9"	Optimum + 4% - 0	A	95% max. density, by ASTM D-698 Method "A"
II	Material as represented by TP-7, depth 1.2' to 8.0' Classified as SM	6"	9"	Optimum ± 3%	A	95% max. density, by ASTM D-698 Method "A"

[1] Maximum permissible lift thickness before compaction

[2] Water content of fill matrix at time of compaction. Variation from water content shown may be approved by the Engineer

[3] For typical compaction curves see sht 43

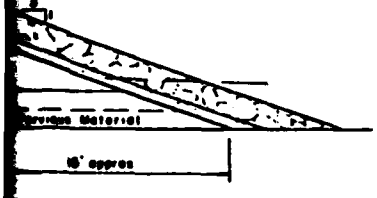
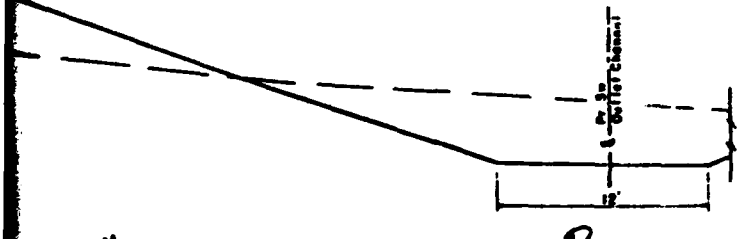


PLATE 10

AS BUILT PLANS

SCALE in FEET



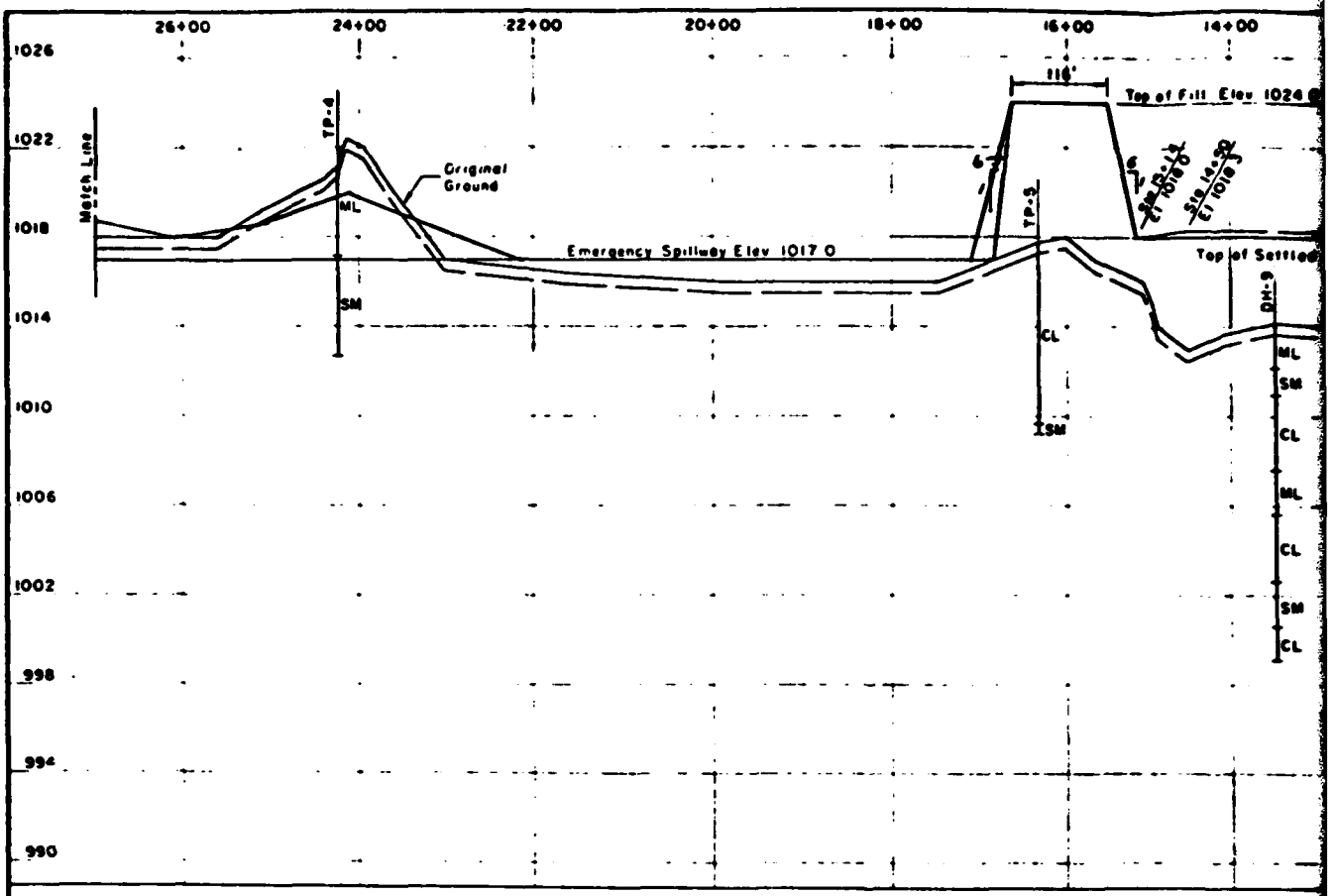
LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM PA-487 B
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA

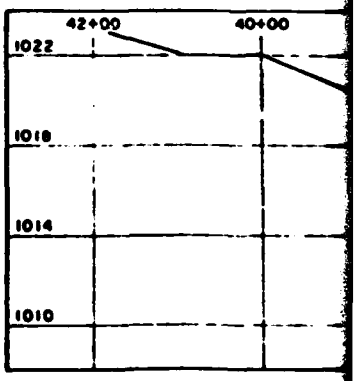
FILL PLACEMENT

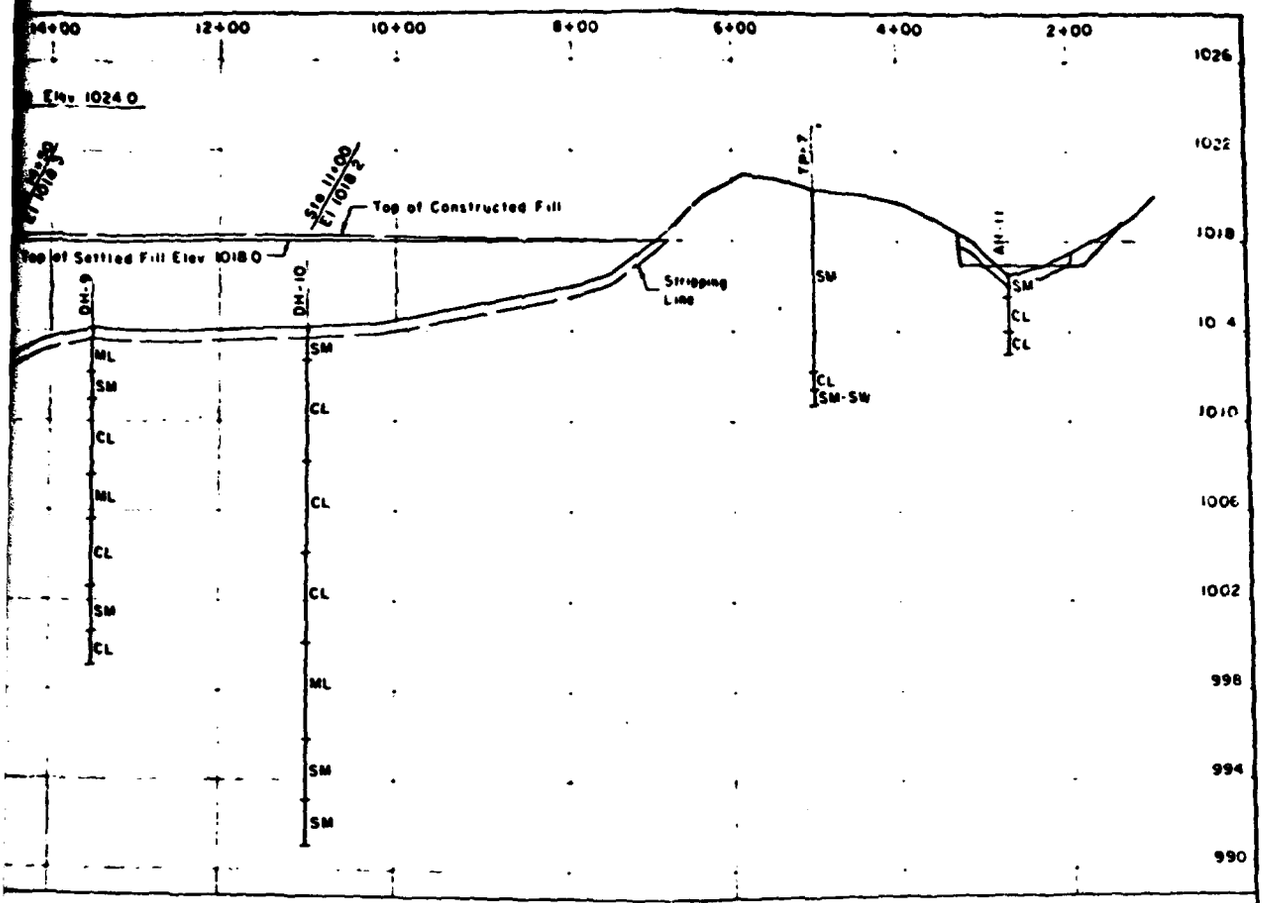
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

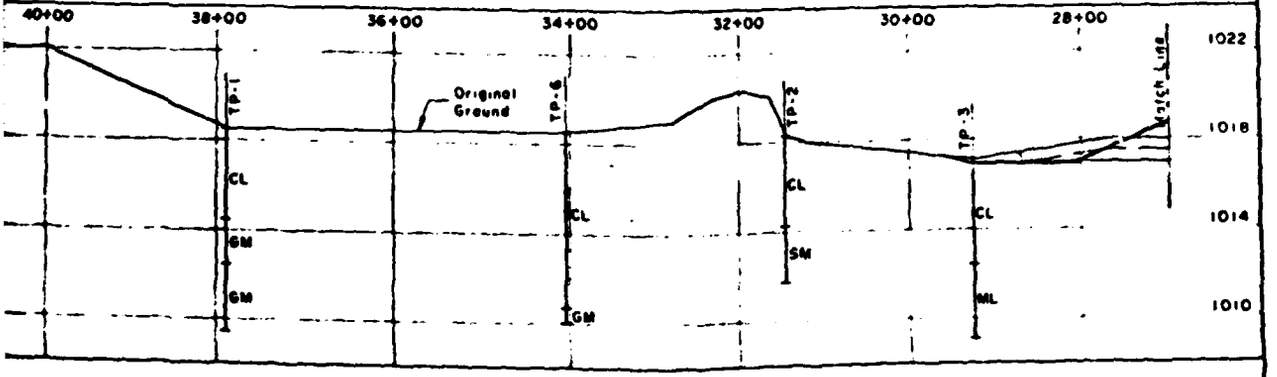
DRAWN [illegible] DATE
TRACED CRISE 3-'72
DESIGNED [illegible]
CHECKED [illegible] 43

PA-487 B-P


26+00
24+00
22+00
20+00
18+00
16+00
14+00
1026
1022
1018
1014
1010
1006
1002
998
994
990
Match Line
TP-4
Original Ground
ML
SM
Emergency Spillway Elev 1017.0
110'
Top of Fill Elev 1024.0
TP-5
CL
SM
Top of Settled
DH-9
ML
SM
CL
ML
CL
SM
CL


42+00
40+00
1022
1018
1014
1010





PROFILE ALONG CENTERLINE OF DAM

PLATE II

CONSTRUCTION NOTES

For logs of drill holes and test pits see sheets 40 thru 42

AS BUILT PLANS

LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM NO. 10-P
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA
PROFILE ALONG ℄ DAM

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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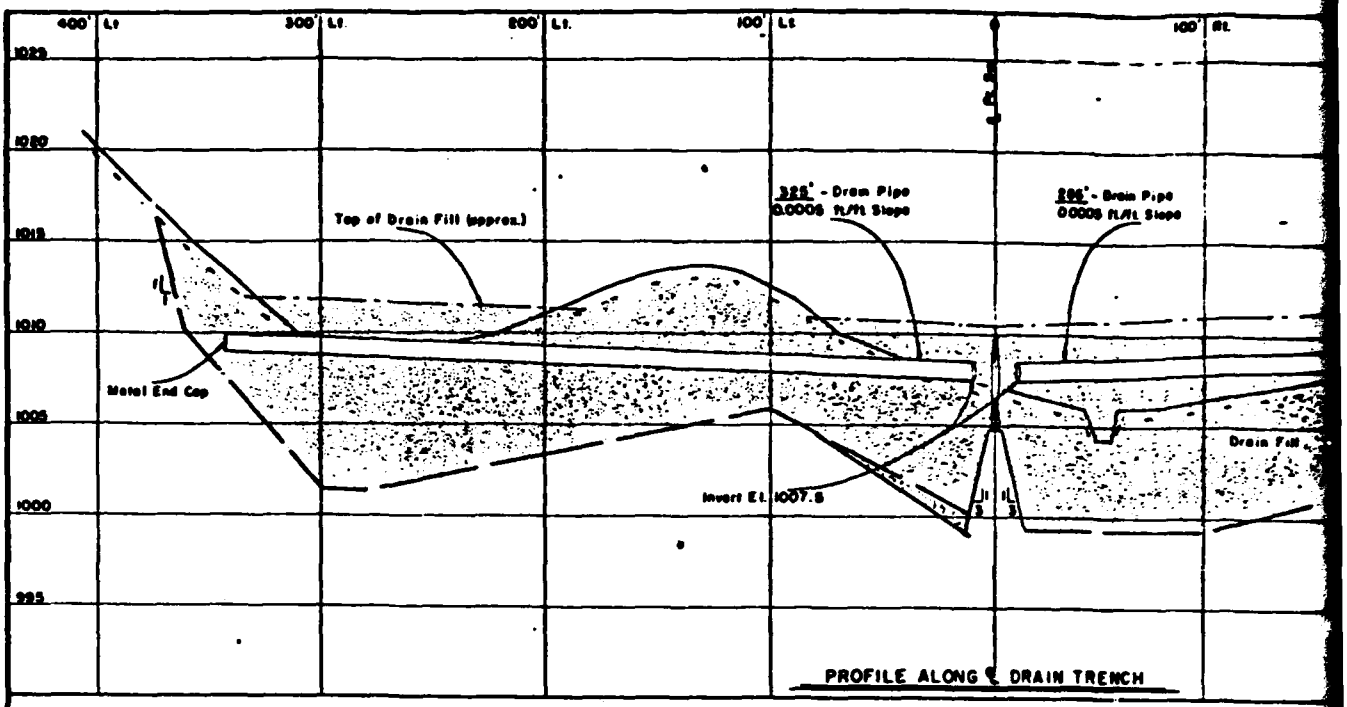
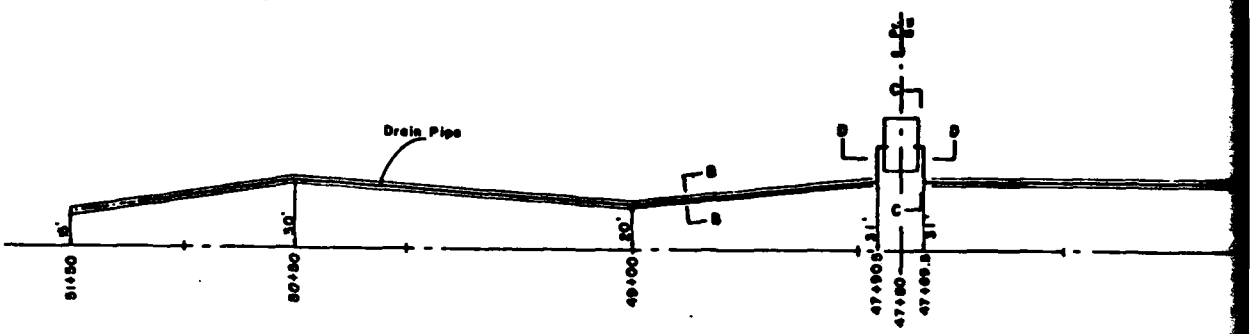
PA-487B-P

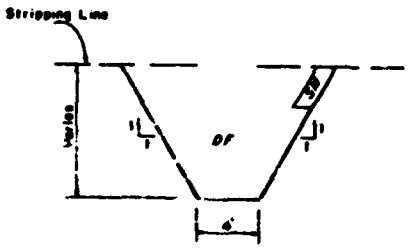




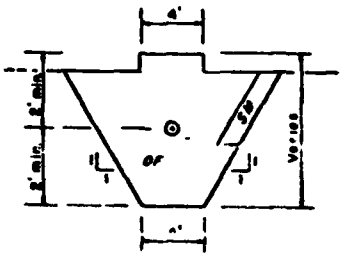
PLAN VIEW

40 20 10 0 40

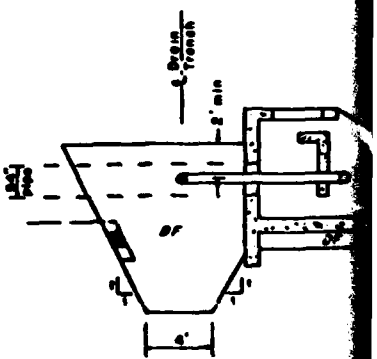
SCALE in FEET



SECTION A-A



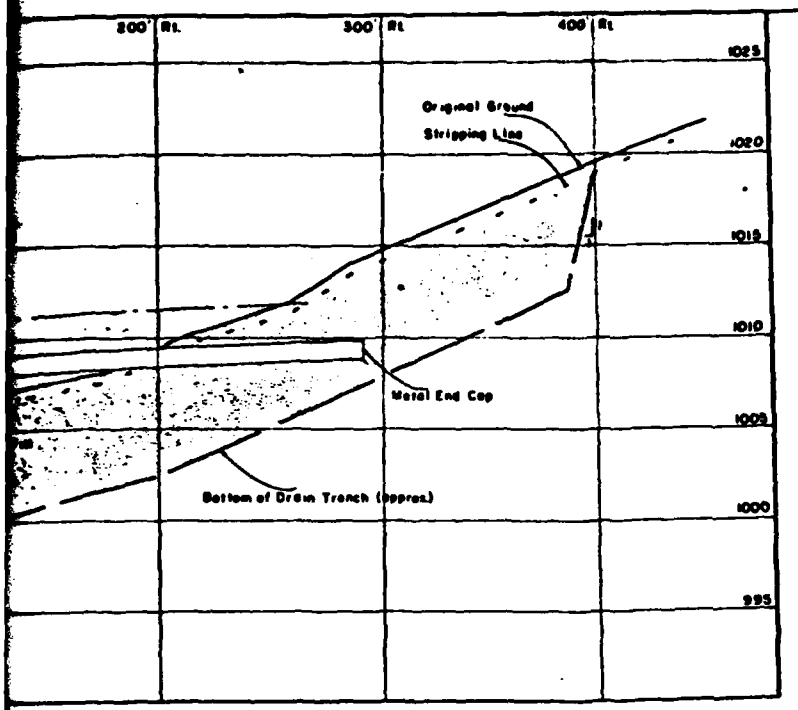
SECTION B-B



SECTION C-C

DF Drain Fill

SM 12" Thick, SM Material, as represented by TP-208 (1.1'-8.0') against the foundation (BRL) as represented by TP-
(10'-6.0') as determined by the Engine



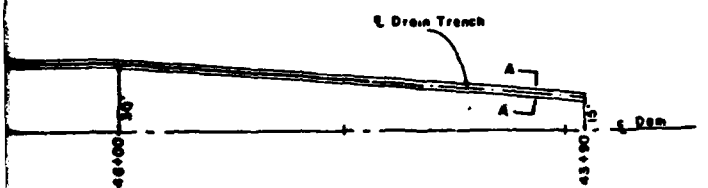
QUANTITY SUMMARY

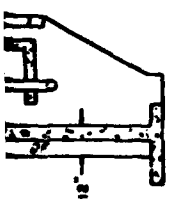
2 - 2' Sections
49 - 13' Sections
4 - 90° Elbows (1'-4" x 1'-4")
2 - Metal End Caps
2 - Small Animal Guards (see sht 26)
651'-8" - Total

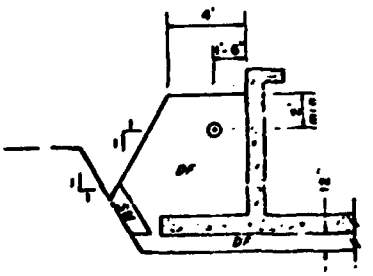
GRADATION LIMITS FOR DRAIN FILL

SEIVE NO	% PASSING (Based on dry weight)
3"	100
2"	74 - 100
1-1/2"	58 - 100
1"	42 - 98
3/4"	33 - 85
1/2"	23 - 68
3/8"	17 - 56
no 4	6 - 30
no 8	0 - 14
no 10	0 - 10
no 200	< 3

All drain pipe shall be Asbestos Cement, Pressure, Perforated, 12" Dia (Spec 545)







SECTION D-D

PLATE 12

AS BUILT PLANS

LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM PA-487A
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA

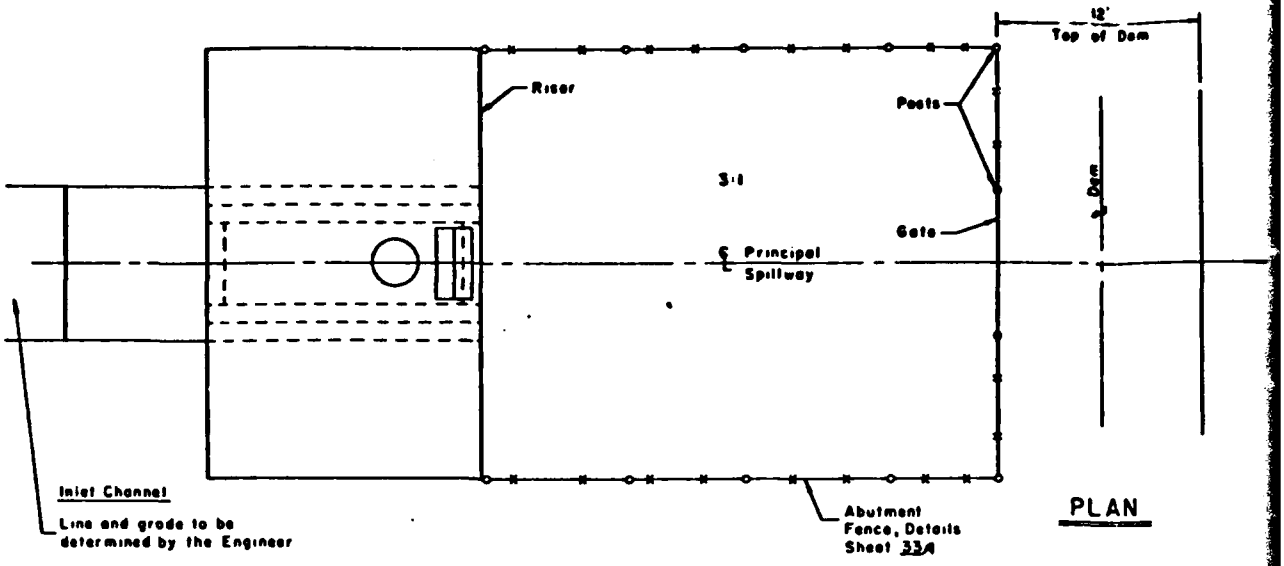
DRAINAGE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

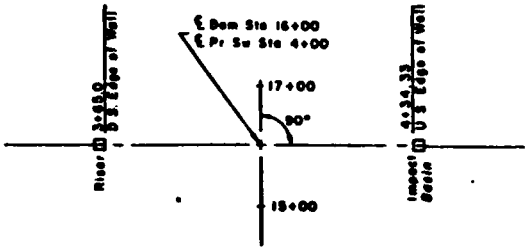
CRISE 3-72

PA-487A-P

2

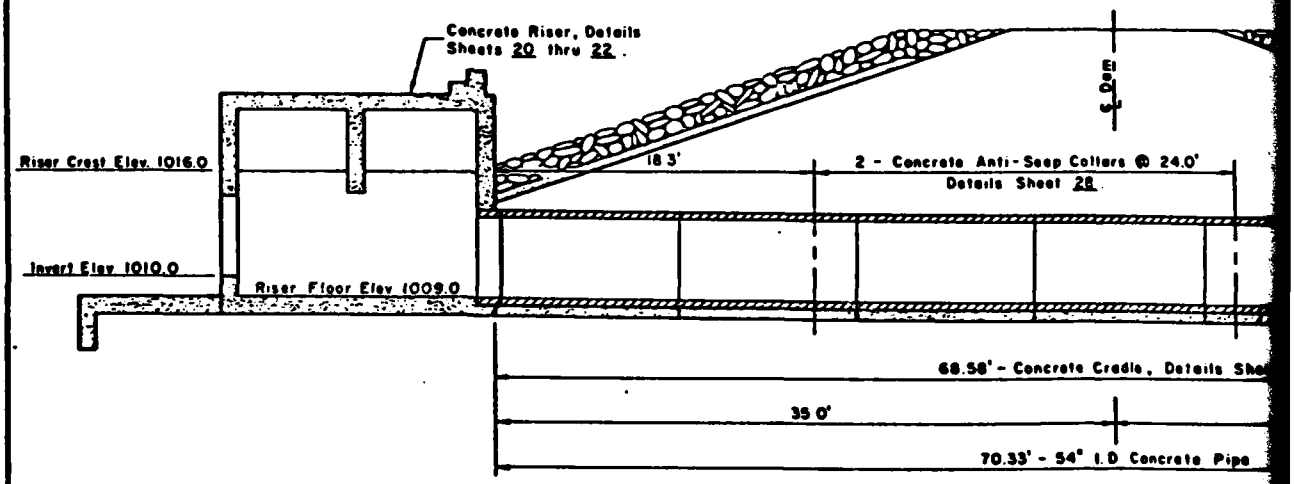


PLAN



℄ PRINCIPAL SPILLWAY LAYOUT

Walkway and Abutment Details Sheet 32.



PROFILE ALONG CENTERLI

0 8
SCAL

CONSTRUCTION NOTES

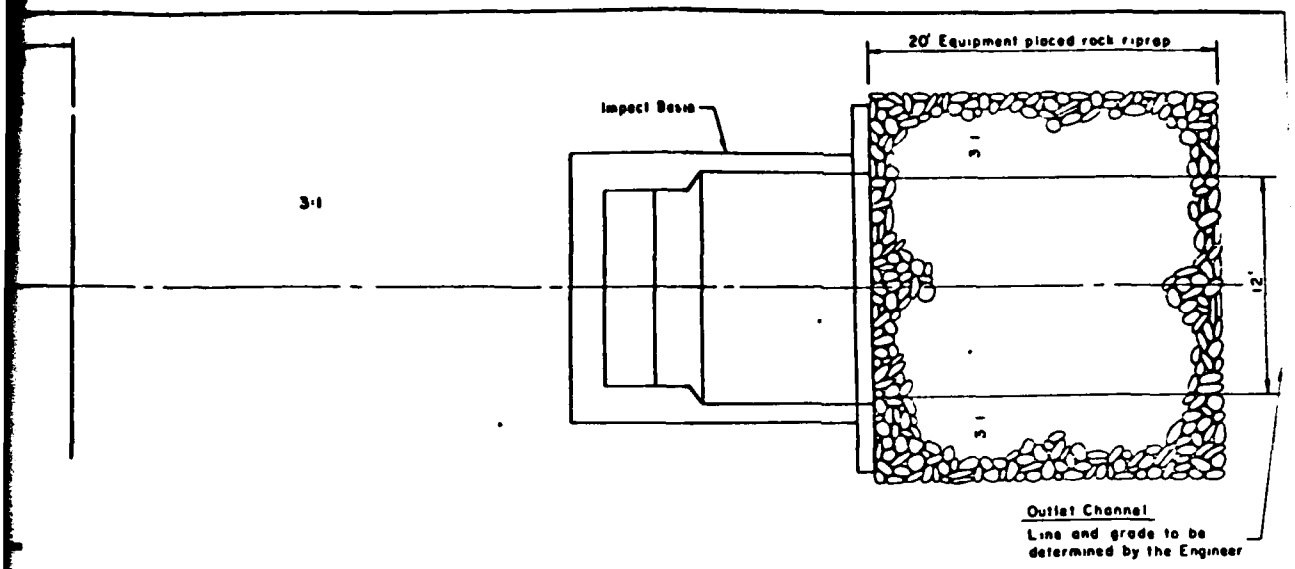
1. Outlet end of 54" pipe (spigot end) to be finished so that no metal is exposed.
2. Pipe layout data will be furnished by the Engineer
3. Layout shown is for 10' conduit sections. If other section are used, quantities and some dimensions will change.

As Built
54" I.D PIPE JOINT DATA

JOINT	DIST. FROM RISER WALL	INVERT EL.
J-1	0.33	1009.00
J-2	20.33	1008.94
J-3	30-33	1008.88
J-4	50-33	1008.70
Outlet	70.33	1008.50

AS BUILT COLLAR DATA FOR 54" I.D PIPE

COLLAR	DIST. FROM RISER WALL	INVERT EL.
I	18.3	1008.94
II	42.3	1008.77



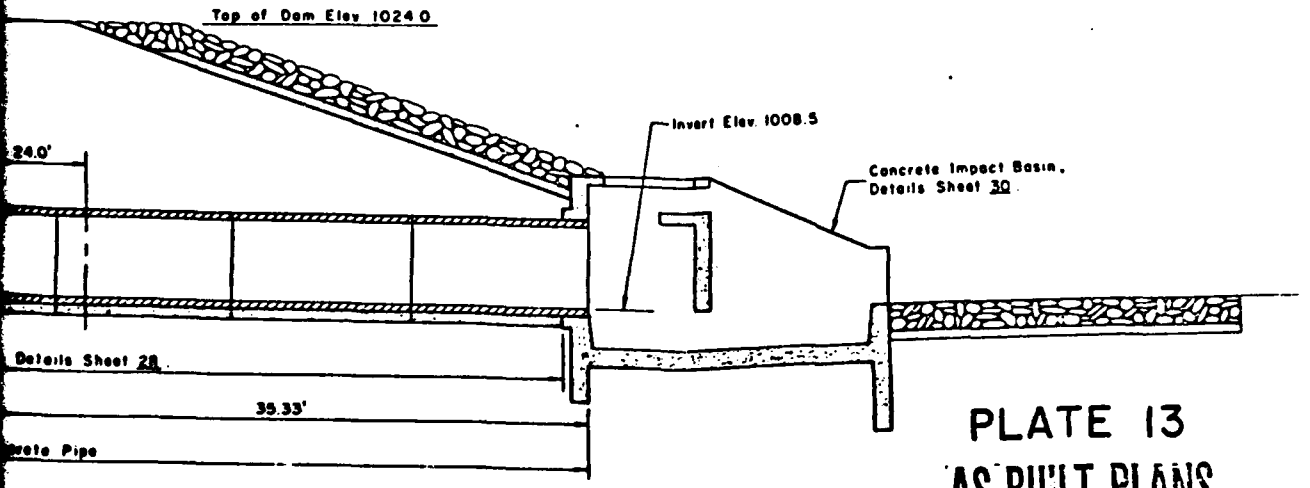


PLATE 13
AS BUILT PLANS

NTERLINE PRINCIPAL SPILLWAY

SCALE

DATA
PIPE

INVERT EL.
1008.84
1008.77

54" I D Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Spec 541 (AWWA C-300 or C-301)

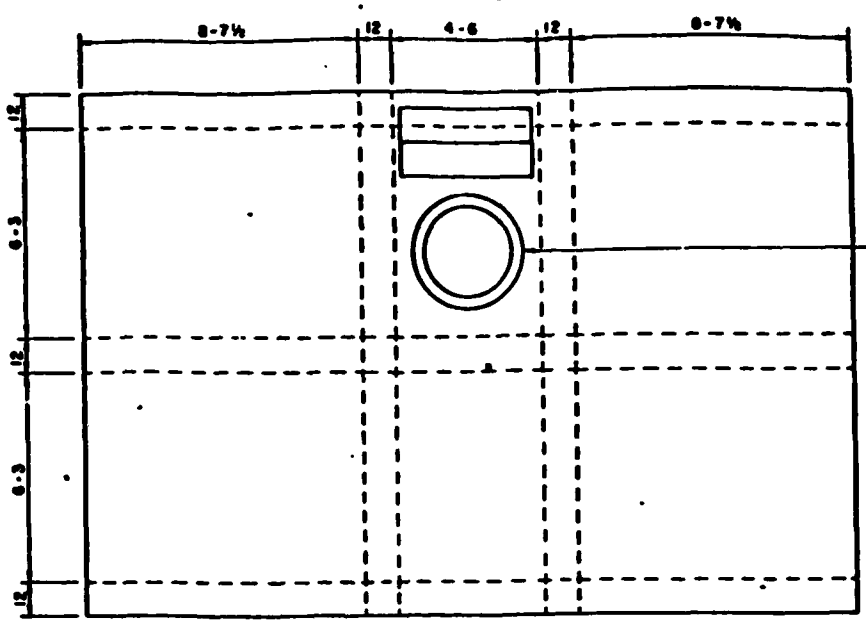
70' - Straight sections
1 - Spigot ring wall fitting (for 12" wall)
70.33' - TOTAL

Pressure head = 20'
Load = 15,000 lbs. per lin. ft., Based on O D of 5.32'
Min. 3 edge bearing strength:
0.01" Crack non-prestressed pipe = 6,850 lbs per lin ft
0.001" Crack prestressed pipe = 5,150 lbs per lin. ft.

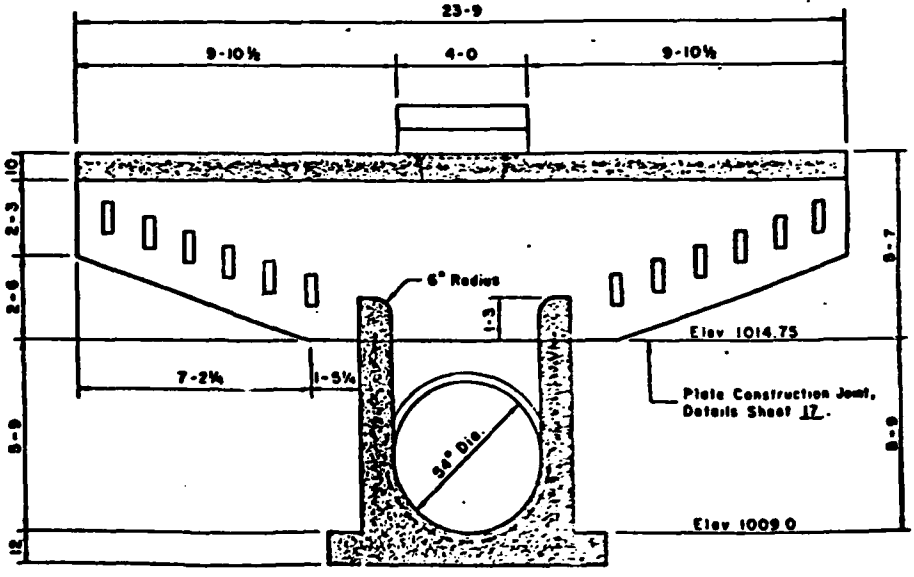
LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM PA-487B
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA
PRINCIPAL SPILLWAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

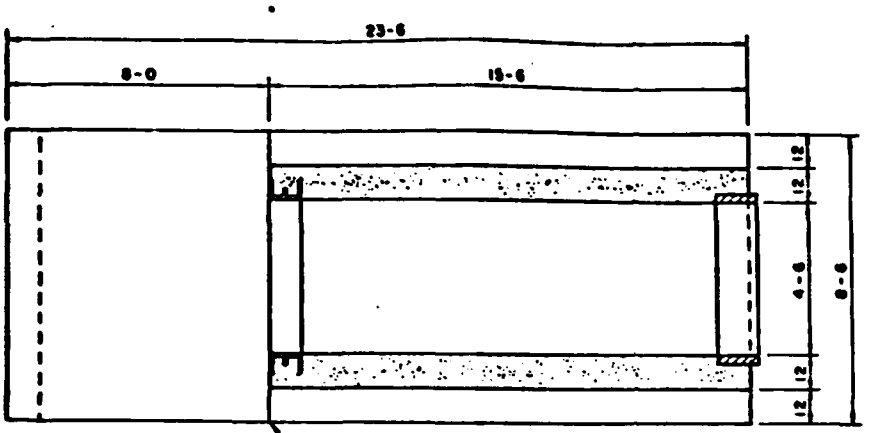
Designed John Gantzmer 4-72
Drawn R A STALTER 2-72
Traced
Checked Alfred Q. Snyder 4-72
Approved by
Title
Sheet No. 14 of 43
Drawing No. PA-487B-P



PLAN - TOP



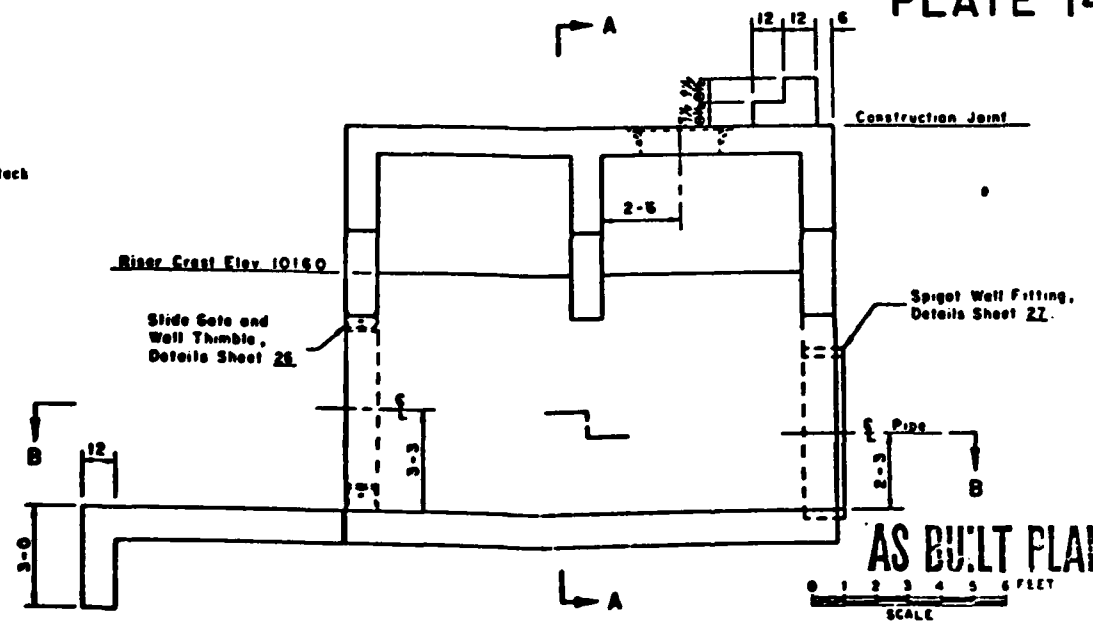
SECTION A-A



8-6 x 1-0 x ¾ Preformed Joint Filler, Bituminous (Spec 535)

SECTION B-B

PLATE 14



AS BUILT PLANS

SIDE ELEVATION

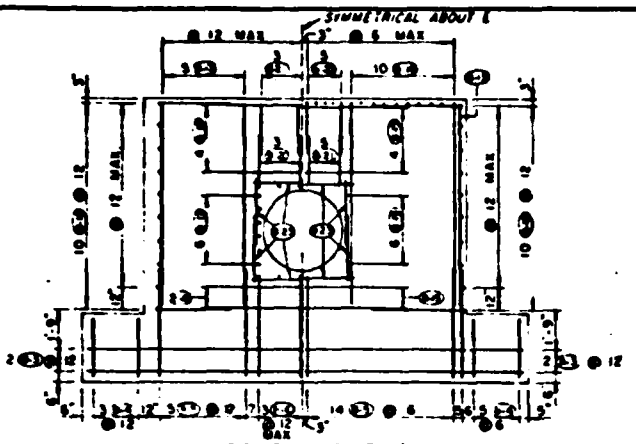
NOTES

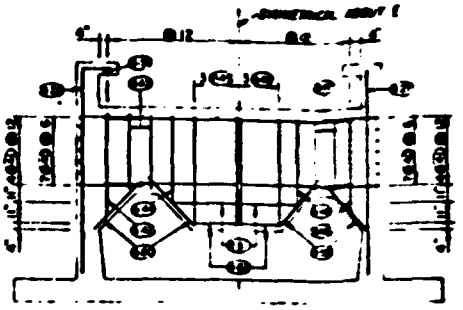
1. Portland Cement type I-A or I with an air-entraining admixture shall be used.
2. Thickness of concrete over reinforcing steel shall be 2" in formed surfaces and 3" in unformed surfaces unless noted otherwise.
3. All exposed edges of concrete to have a 1" chamfer unless otherwise noted.
4. Bar dimensions are out to out of bar.

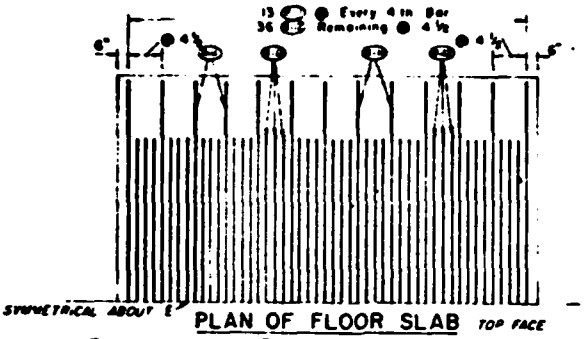
LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM PA-487B
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA
RISER STRUCTURAL DETAILS

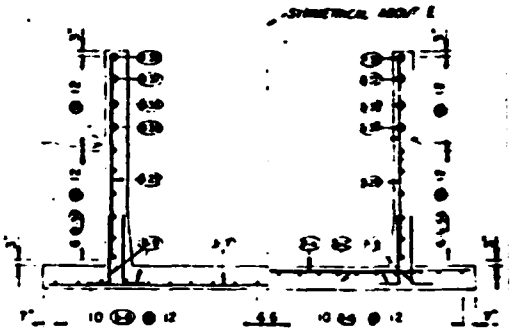
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

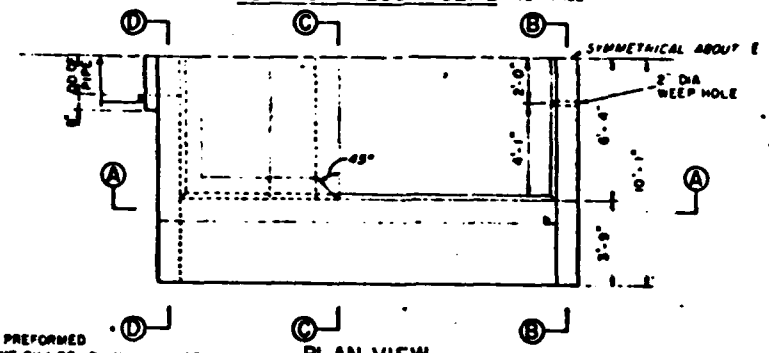
Designed [illegible] Date 6-72
Drawn R.A. STALTER 10-71
Traced [illegible] 6-72
Approved by ...
Title ...
Sheet No. 20 of 43
Drawing No. PA-487B-P

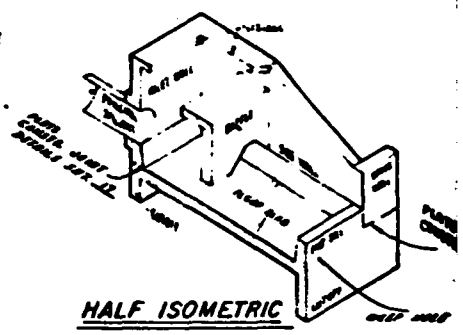

SYMMETRICAL ABOUT ℄
DOWNSTREAM FACE
SECTION D-D
UPSTREAM FACE

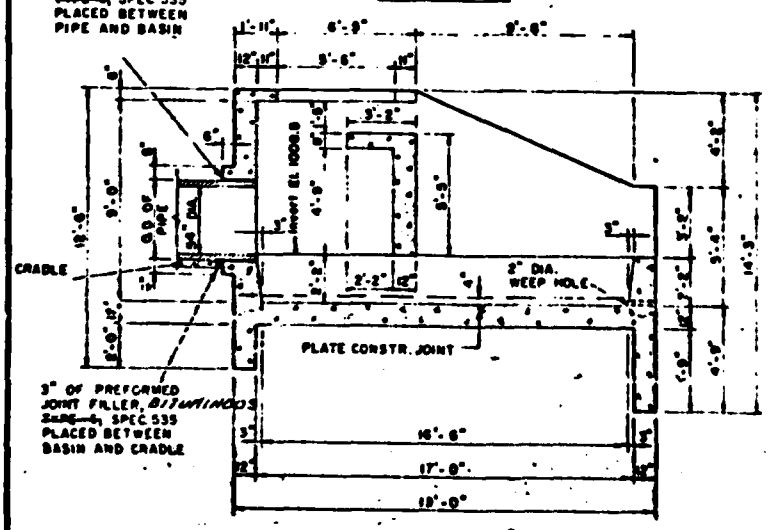

OUTSIDE FACE
SECTION THRU BAFFLE

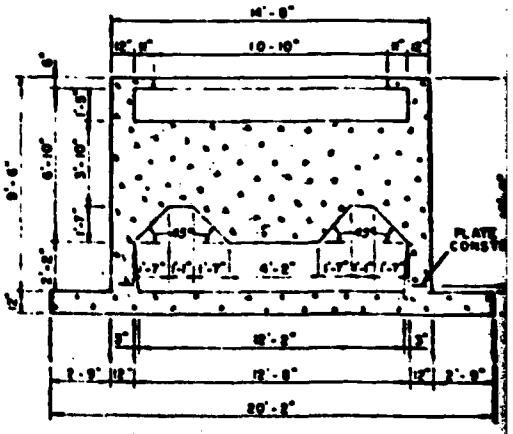

SYMMETRICAL ABOUT ℄
PLAN OF FLOOR SLAB
TOP FACE


OUTSIDE FACE
SECTION C-C


SYMMETRICAL ABOUT ℄
2" DIA WEEP HOLE
45°
PLAN VIEW


HALF ISOMETRIC


½" PREFORMED JOINT FILLER, BITUMINOUS
SPEC 535
PLACED BETWEEN PIPE AND BASIN
CRADLE
2" DIA. WEEP HOLE
PLATE CONSTR. JOINT
3" OF PREFORMED JOINT FILLER, BITUMINOUS
SPEC 535
PLACED BETWEEN BASIN AND CRADLE
SECTION ON ℄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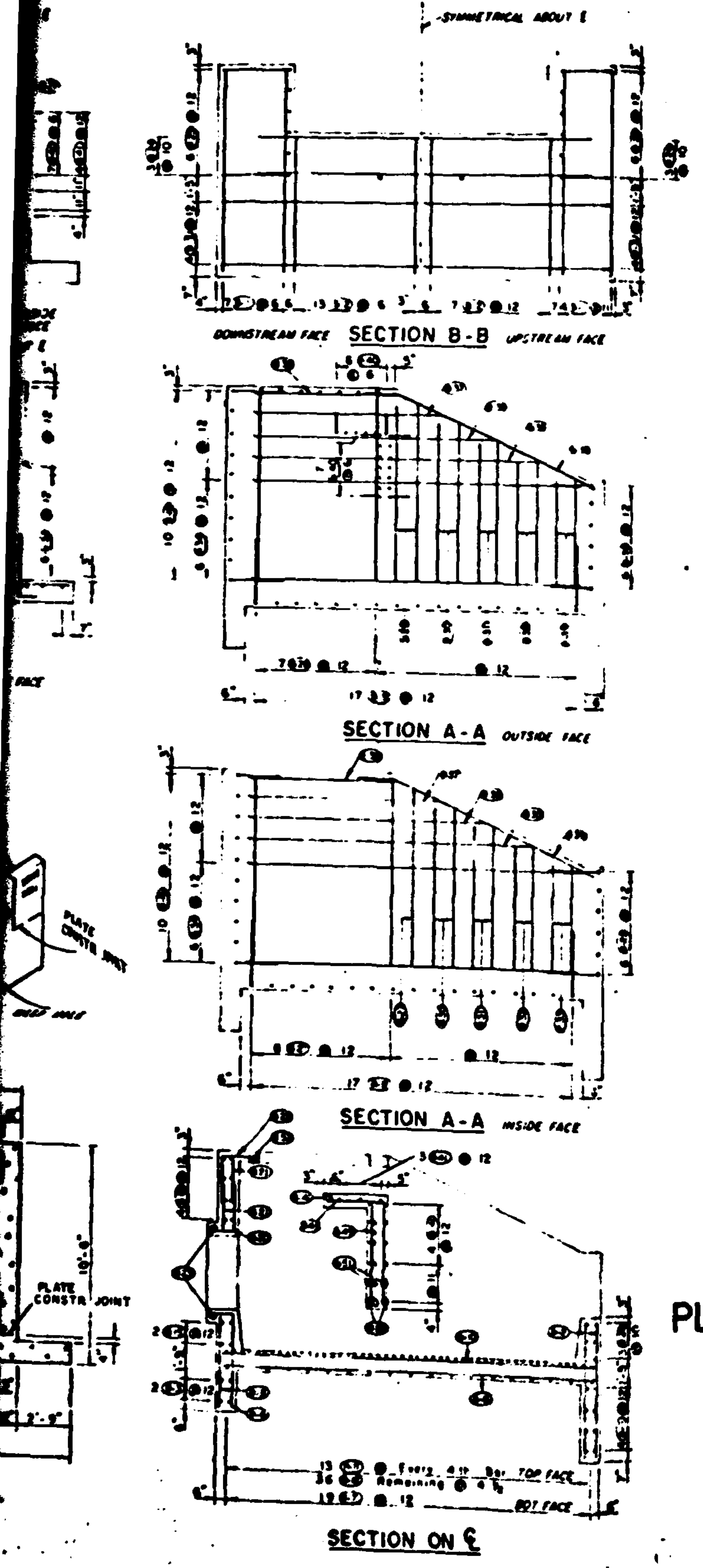
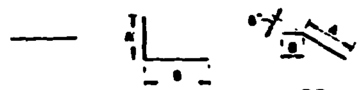


STEEL SCHEDULE

MARK	LOCATION	QUAN	SIZE	LENGTH	TYPE	A	B	TOTAL
B-1	CUTOFF	22	5	9-6	1			209
2		40	5	6-6	1			260
3		12	5	19-9	1			237
4		16	5	2-6	1			40
B-5		38	5	5-0	1			190
6		5	5	5-6	21	4-6	1-0	27
7	FLOOR SLAB	19	5	19-9	1			375
8		20	5	18-6	1			370
9		68	5	4-0	21	3-0	1-0	272
B-10		20	6	18-6	1			370
11		13	7	19-9	1			256
12		36	7	15-3	1			549
13	INLET WALL	12	5	9-0	1			108
14		20	5	10-6	2	9-0	1-6	210
B-15		12	5	9-6	1			114
16		20	5	5-10	21	3-9	2-1	116
17		12	5	3-9	21	2-9	1-0	45
18		20	5	6-7	2	4-0	2-7	131
19		12	5	2-9	1			33
B-20		5	5	3-3	21	2-3	1-0	16
21		15	5	2-3	1			33
22		10	5	3-9	21	2-3	1-6	37
23		8	5	4-0	1			32
24	WING WALLS	6	5	17-6	1			105
B-25		12	5	5-5	21	3-4	2-1	65
26		12	5	5-4	21	2-9	2-7	64
27	SIDE WALLS	16	5	9-0	1			44
28		14	5	10-6	21	9-0	1-6	147
29		6	5	8-6	1			5[illegible]
B-30		8	5	7-6	1			60
31		8	5	6-9	1			54
32		8	5	6-0	1			48
33		8	5	5-0	1			40
34		24	5	16-6	1			396
B-35		4	5	14-3	1			57
36		4	5	11-9	1			47
37		4	5	9-6	1			38
38		4	5	7-3	1			29
39		4	5	12-7	22	11-0	1-7	50
B-40	BAFFLE	40	6	4-0	21	3-0	1-0	160
41		12	5	11-3	1			35
42		2	5	7-12	21	4-6	2-8	14
43		4	5	5-11	2	3-3	2-8	23
44		2	5	6-5	21	3-9	2-8	12
B-45		5	5	7-8	21	5-0	2-8	38
46		2	5	4-6	1			9
47		4	5	3-3	1			13
48		2	5	3-9	1			7
49		5	5	5-0	1			25
B-50		8	5	3-0	1			24
51		4	5	6-0	1			24
52	BAFFLE	2	5	4-3	1			8
53	OVERHANG	1	5	12-6	1			12



BAR TYPES

QUANTITIES THIS SHEET ONLY

REINFORCING STEEL
NO 5 BARS 4601.6 LIN FT 4799.5 LBS
NO 6 BARS 530.0 LIN FT 796.1 LBS
NO 7 BARS 809.8 LIN FT 1646.9 LBS
TOTAL 7242.5 LBS

CONCRETE
CLASS 4000 40.1 CU YDS

PLATE 15 AS BUILT PLANS

SCALE

LITTLE SHENANGO RIVER WATERSHE[D]
MULTIPLE PURPOSE DAM PA-487B
CRAWFORD AND MERCER COUNTIES, PENNSYLVANI[A]
IMPACT BASIN DETAILS

U.S. DEPARTMENT OF AGRICULTU[RE]
SOIL CONSERVATION SERVICE

PA-487B-[illegible]

Construction Details:
See Sheet 20

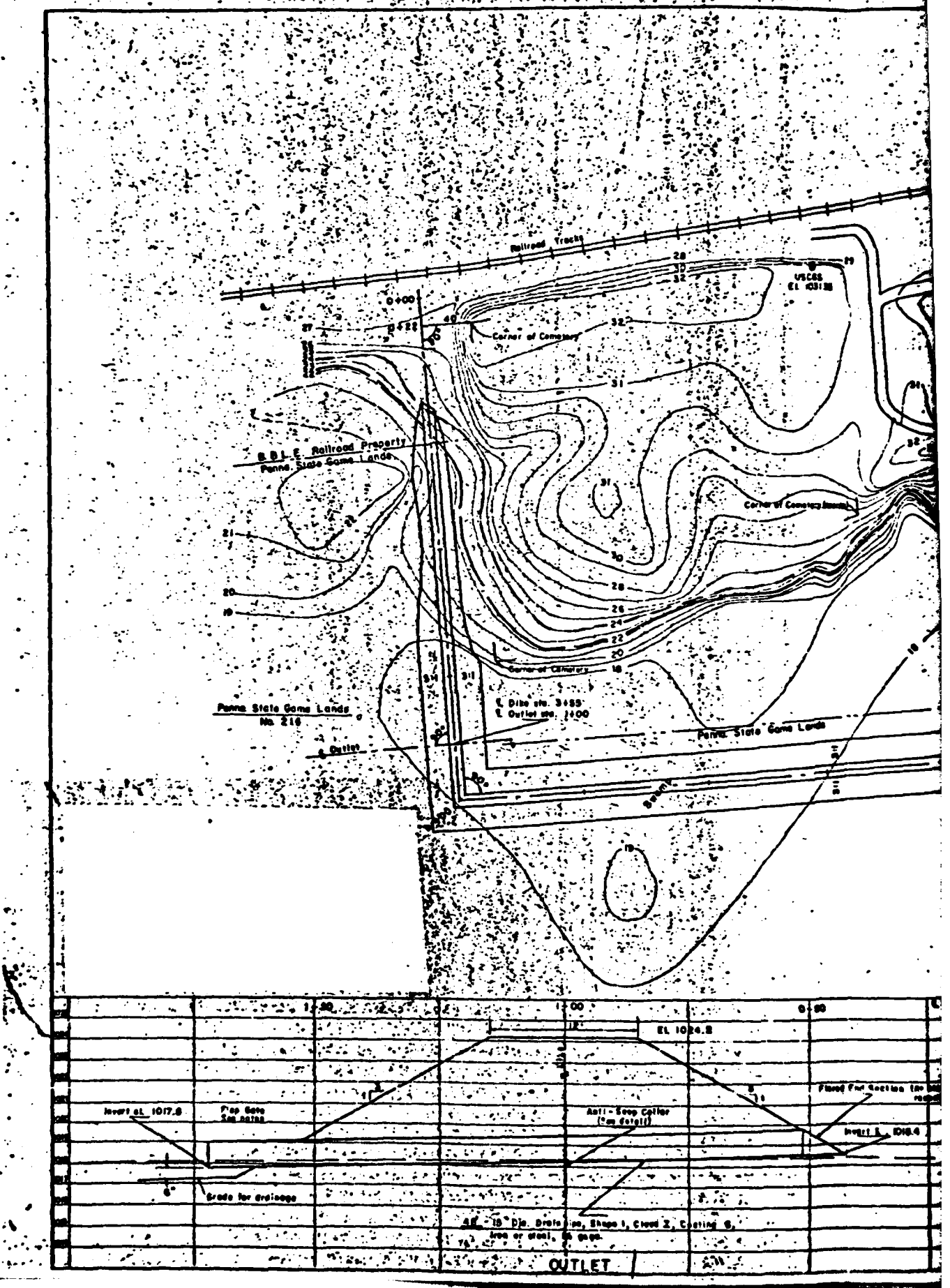
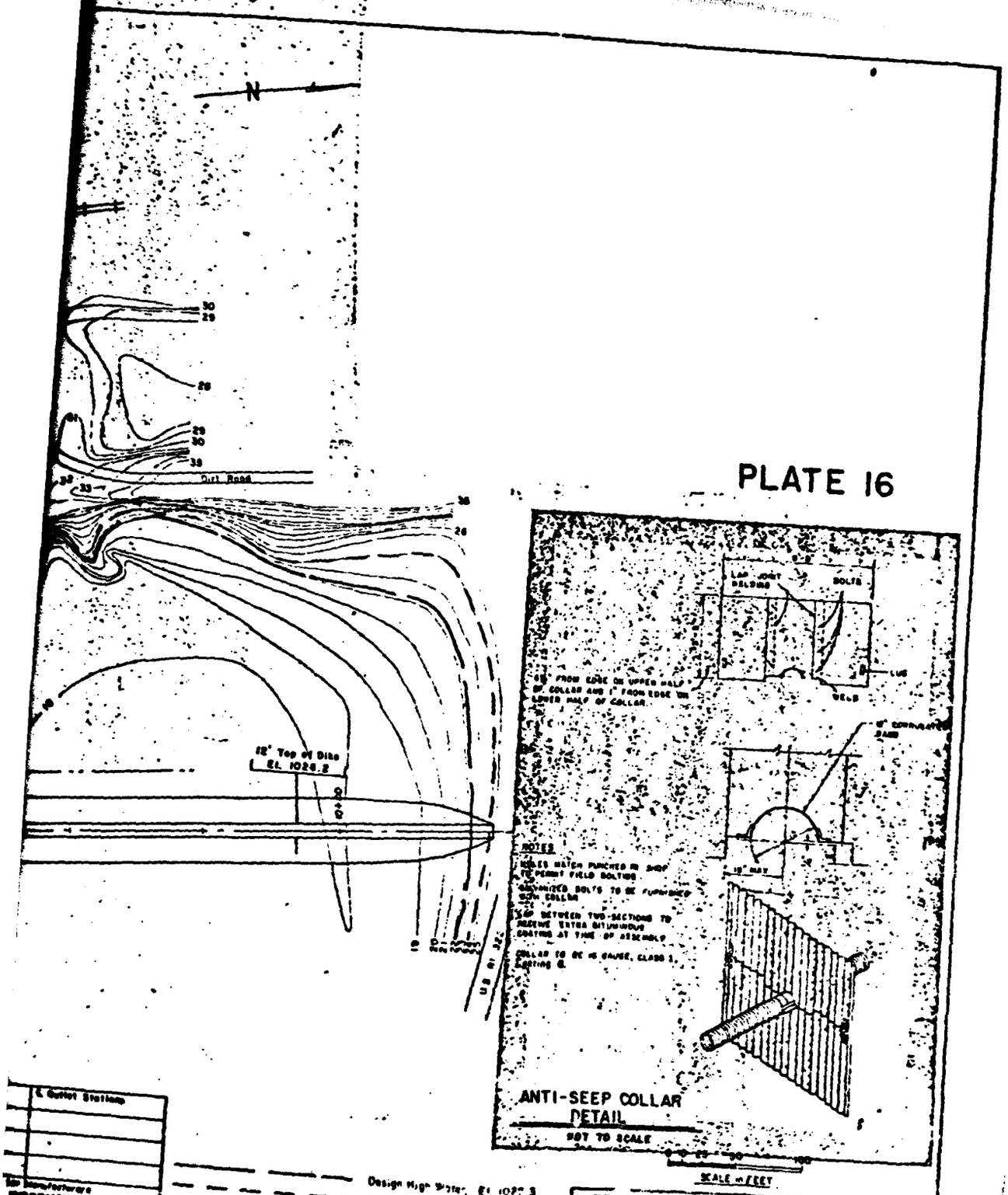

Railroad Tracks
B.B.I.E. Railroad Property
Penna. State Game Lands
Penna. State Game Lands
No. 216
Corner of Cemetery
Corner of Cemetery
℄ Dike sta. 3+55
℄ Outlet sta. 1+00
Penna. State Game Lands
℄ Outlet
Invert el. 1017.8
Pipe Gate
See notes
Grade for drainage
EL 1024.8
Anti-Seep Collar
(See detail)
Flood Plat Section (See
Invert E. 1018.4
OUTLET

PLATE 16



ANTI-SEEP COLLAR DETAIL

NOT TO SCALE

SCALE in FEET

0 25 50 100

AS BUILT PLANS

Flap Gate Notes

1. For 18" dia. CMP
2. Type WLP-1, Material Spec. 574.
3. Clean OS.
4. Spigot Back.
5. Paint in accordance with Paint System A, Construction Spec. 66.

LITTLE SHENANGO RIVER WATERSHED
MULTIPLE PURPOSE DAM PA-487
CRAWFORD AND MERCER COUNTIES, PENNSYLVANIA
CEMETERY PROTECTION
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Engineer — Date 6-72
Drawn — C. DRISE 3-58
Traced — Date 6-72
Checked — Date 6-72
Approved — Date 6-72

PA-487-P

APPENDIX F

REGIONAL GEOLOGY

UPPER AND LOWER DAMS
NDI No. PA 00389, PennDER No. 20-55, SCS Nos. 487A and B

REGIONAL GEOLOGY

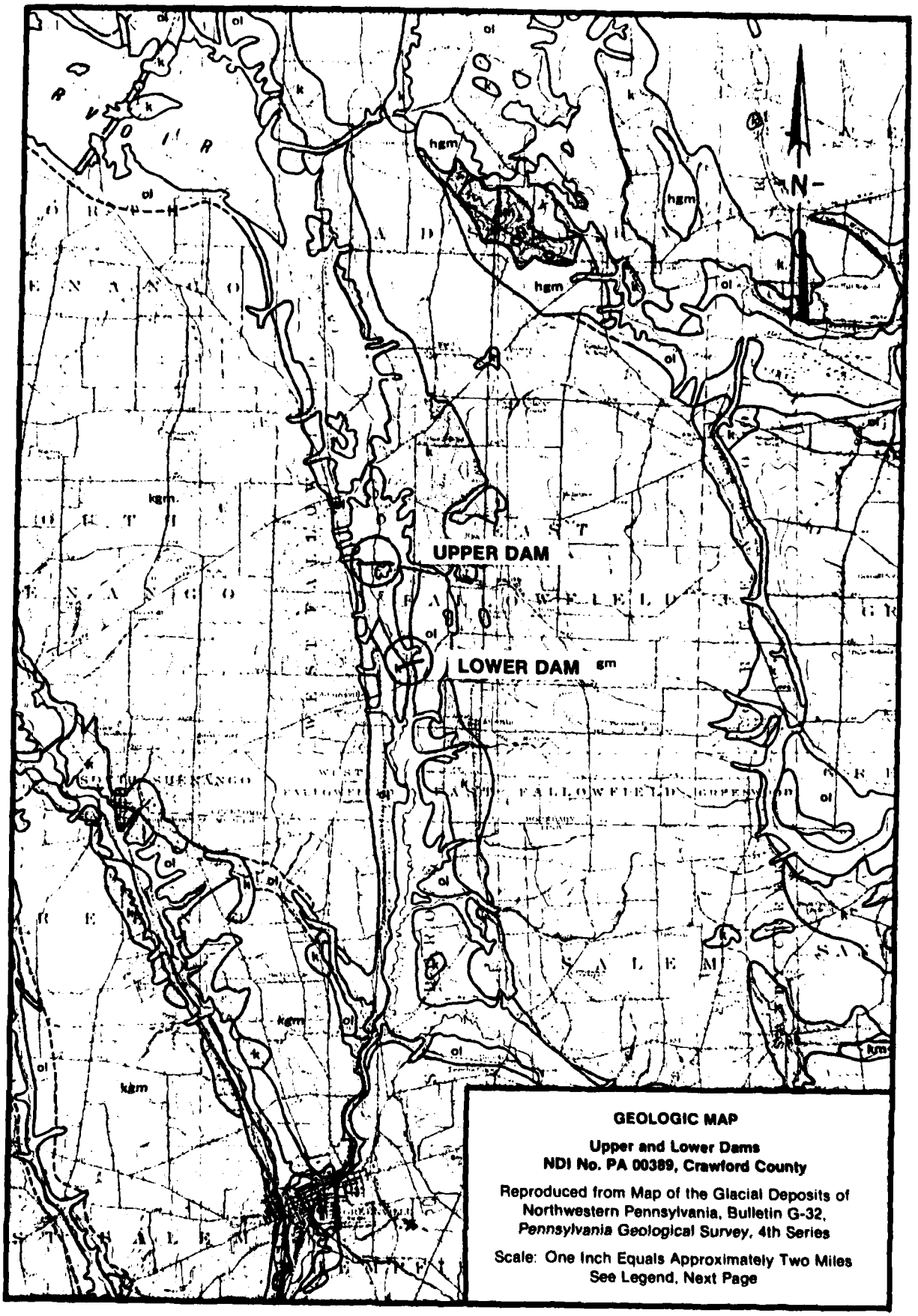
Both Upper and Lower Dams are located in a glaciated area of the Appalachian Plateaus physiographic province. Thick deposits of outwash and kame terraces are located beneath both dams. Old well logs indicate a depth to bedrock as great as 275 feet. The actual depth to bedrock below the dams was not determined during the exploration program.

Lower Dam (SCS No. PA 487A) is underlain by silty sand and gravel (GM, GM-GW, and SM) deposited by the Illinoian and Wisconsin ice advances. During minor advances and retreats of the glaciers, streams rapidly eroded and deposited this material forming terraces (kame) and other thinly stratified deposits of sand and gravel. As the glacier retreated for the last time, it left traces of the Kent ground moraine, composed of a thin (2 feet to 8 feet) layer of sandy silts (ML to SM) on the left abutment. Firm, non-cohesive sands and gravels are located on the right abutment. Near the center of the floodplain is a nine foot thick deposit of silt (ML). With the exception of the cut-off trench, the foundation of the dam was placed on this deposit.

Upper Dam (SCS No. PA 487B) is approximately one mile upstream from the Lower Dam and the general geology is the same as that discussed above except that Upper Dam is situated on recent alluvial material up to 20 feet deep and on a wider floodplain.

Bedrock units underlying the glacial deposits are members of the Pocono Group, Mississippian System. This group consists primarily of sandstone and shale.

The map on the following page shows the approximate limits of the surficial glacial deposits at the dam sites.



GEOLOGIC MAP

Upper and Lower Dams
NDI No. PA 00389, Crawford County

Reproduced from Map of the Glacial Deposits of Northwestern Pennsylvania, Bulletin G-32, *Pennsylvania Geological Survey*, 4th Series

Scale: One Inch Equals Approximately Two Miles
See Legend, Next Page

LEGEND

PLEISTOCENE

ILLINOIAN OR WISCONSIN

ILLINOIAN

RECENT OR PRE-PLEISTOCENE

Kent Till

	km	Kent end moraine Till (sandy loam)
	kfm	Findley Lake recessional moraine Till (loam)
	kcm	Clymer recessional moraine Till (loam)
	kgm	ground moraine Till (loam becoming sandy loam toward the east and southeast)
Inner phase	ii	ground (?) moraine
Outer phase	io	ground moraine (?)
Undifferentiated members of units above	k	kames, kame terraces, kame moraines, and eskers
Undifferentiated members of units above	ol	outwash (valley trains), river terraces, lake deposits including beaches of former high levels of Lake Erie
Undifferentiated		stream alluvium and bedrock